THE ENGINEER.

The Shipping, Engineering and Machinery Exhibition at Olympia.

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The Shipping and Engineering Exhibition, to give it its short title, was opened yesterday in Olympia, and will remain open for two full weeks, the closing day being September 24th. Such an Exhibition is undoubtedly an important function in the engineering world, as it brings into prominence the activities of factories throughout the country and to some extent those of our neighbours abroad. It does not fall to the lot of every engineer, even within our own country, to be able to come to London to study the products of his *confrères*, but there must be, nevertheless, many who might be tempted to find the time if they only appreciated the wide scope of these occasional exhibitions.

With this object in view, we have collected together as much advance information as is possible of the exhibits at Olympia, and in this Supplement give a selection from these particulars. In this connection it should be borne in mind that our Supplement does not pretend to cover the Exhibition completely—in a mere twenty pages that would be impracticable—and that there are many other stands which will be dealt with in the columns of The Engineer.

Davey, Paxman and Co., Ltd.

Throughout the Exhibition there is evidence of the growing competition of the oil engine with the steam engine, and it is fairly obvious that, given a stable oil market and an oil engine which had the flexible characteristics of the steam engine, there would be fewer boilers installed for power-producing plants, except in those circumstances in which the resultant exhaust steam might be of subsequent use, or in which the units must be of a size beyond the capacity of internal combustion engines, as we now know them. In the circumstances, it is rather interesting to find that a firm—Davey, Paxman and Co., of Colchester—which has always been particularly associated with steam engineering, has seriously taken up the manufacture of heavy oil engines, and has, so far as we can see, succeeded, to a very large extent, in approaching the pleasant characteristics of the steam engine while retaining the economical features of the internal combustion engine.

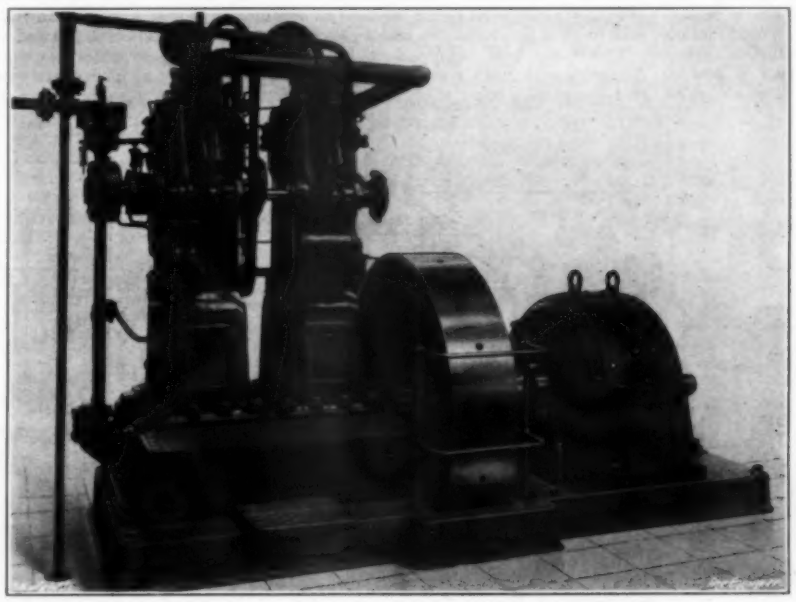


FIG. 1—80 H.P. OIL ENGINE GENERATING SET—PAXMAN

The design of the new vertical oil engine, an example of which is illustrated in Fig. 1, exhibited at Olympia, has been got out in collaboration with the Blackstone Company. The engines which are actually exhibited are one of 25 H.P. with one cylinder, and the other of 120 H.P. with three cylinders, but we deliberately introduce the two-cylinder set shown in Fig. 1, which runs at a speed of 330 r.p.m, as we are more intimate with its performance.

The general principles of the prototype of these engines have already been described in The Engineer, but it may be as well to point out that they are of the four-stroke cycle type, with "solid" injection, and are intended to run on the lowest grades of fuel oil. But the outstanding feature of the new Paxman engine is its flexibility, and we have tested it rather severely. Thus, for instance, in the case of a three-cylinder set of 120 H.P., it was started up against approximately three-quarters of full load, when quite cold, and after one revolution under compressed air started firing and picked up speed steadily. The effort which the engine had to exert at starting may be gauged by the fact that the brake was loaded to such an extent that at full speed it would just lift 280 lb. at a radius of just over 7ft. Of course, the air pressure used in starting overcame the static friction, but the crank shaft was only just turning before the explosions started, and took up the load. Another test which we applied to this engine was to start it up, again quite cold, as slowly as possible, and then to apply the load by means of the brake. This process showed that the engine would develop the torque equivalent to full load at a speed approximating to one-third the normal running conditions. We have subjected the engine to several other trials, and consequently feel that the makers are justified in their claim that it embodies many of the convenient features of the steam engine.

In the case of an internal combustion engine it is difficult to ascribe the reason for its performance, in one way or another, to any individual characteristic, and we believe that the Lentz exhaust valve gear, which we have already described in connection with the Blackstone oil engine helps very considerably towards the easy running of the engine; but there is no doubt that the system of injecting the charge of fuel oil is of primary consideration.

The oil is taken from a service tank by a set of pumps, one to each cylinder of the engine, which deliver at about 15 lb. per square inch. The quantity of oil delivered by these pumps is determined, according to the load on the engine, by the governor dropping wedge-shaped pieces behind the ends of the pump plungers in such a manner that their suction stroke is limited more or less. The object of this scheme is, of course, to limit the duty of the governor to the moving of the wedge-shaped abutment. It has not to overcome any further resistance, so that very precise control of the speed can be secured with a light governor.

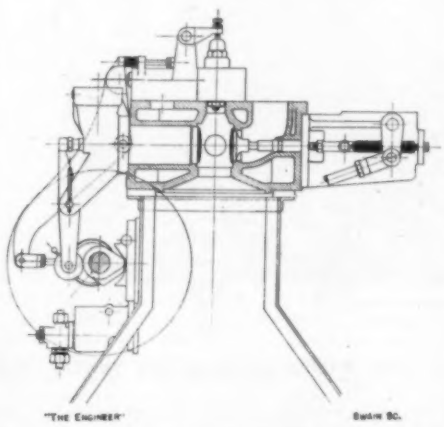


FIG. 2—CYLINDER HEAD

The fuel oil delivered, in quantities according to the load, is sent to plunger pumps in the "fuel blocks" on each cylinder head—see Fig. 2. The oil forces back a plunger in the new pump, and is entrapped between a triple non-return valve and the spraying valve in the cylinder head. About this time a rocking lever, operated by the half-time cam shaft, compresses a spring behind the pump plunger, but has no other effect, except compressing the spring, as the oil cannot escape. At the proper time, as regards the movement of the main piston, a tappet on the rocking lever engages with push rod and a bell crank and lifts the valve of the spraying jet. The full energy of the compressed spring is then immediately available to force the whole of the oil in the fuel pump to the combustion chamber, through four minute holes, which effect a very fine atomisation of the oil—a condition which we have tested in several directions.

Fig. 2 also gives a good idea of the arrangement of the combustion chamber. The exhaust valve is on the right, and is worked by a large excentric on the cam shaft and the rocking cam we have already described. The inlet valve is on the left, and is carried by a liner, or separate seating. This liner can easily be removed, bringing with it the valve, and it can then be ground in conveniently on the bench. With the inlet valve removed the exhaust valve is exposed, and can be pulled forward if necessary. It will be seen that the cylinder head is conical, and is surmounted by a cylindrical combustion chamber. The piston fits up close into this space, and is provided with annular passages, up which the compressed charge rushes just at the end of the stroke and creates such a turbulence that the oil spray and the air are thoroughly mixed together.

As a final note on the general characteristics of this engine, it may be mentioned that we have thrown on and off full load practically instantaneously, and, although in neither case was there a tachometer on the set, it was obvious from the beat of the exhaust, that the speed of the engine did not rise or fall by more than, say, 1·5 per cent., while the speed of the engine quickly reverted to the normal.

Petters (Ipswich), Ltd.

A comprehensive display of oil engines will be found on the stand which represents the combined outputs of Petters Ipswich and Yeovil works, and the largest exhibit is a 125-kW three-cylinder auxiliary generating set, illustrated in Fig. 3. This engine, as well as the 55 B.H.P. propulsion set, is one of the firm's latest "C" type models. It will be remembered that this particular type of oil engine was first shown at the Shipping, Engineering and Machinery Exhibition of November, 1925, and was described in the Special Exhibition Supplement issued by The Engineer on that occasion. There has been no departure from the standard design, but we may mention that in the new engines, means have been introduced whereby when adjusting the fuel valves, any wear on the valve parts can easily be compensated. The present lubricating system is also characterised by a greater simplicity and accessibility which enables the pipes to be quickly dismantled and cleaned.

The 125-kW set, as will be seen from our illustration, comprises a three-cylinder, two-stroke cycle, airless-injection, heavy oil engine, coupled direct to the generator, which is of the direct-current, 220-volt, compound-wound, open-type, with special drip-proof end shields, and manufactured by the Sunderland Forge and Engineering Company, Ltd. The engine has a designed output of 187 B.H.P., when running at a normal speed of 275 r.p.m., and the

cylinders are 14in. bore with a stroke of 16in. There is a combination bedplate for the engine and generator, and we may remark on the comparatively small flywheel, which is enclosed in a planished steel casing. We are informed that even with this moderate sized wheel the two-cycle principle of operation enables a cyclic variation of $^1/_{230}$ to be obtained, with corresponding steady running and absence of flicker.

A point in the cylinder design is the employment of inclined air scavenge ports of the nozzle type, which deflect the air towards the top of the cylinder without the use of a deflector on the piston. It will be seen that the piston head is conical in shape, the inside of the cylinder head being inclined to conform with it and to give the requisite small clearance.

There are two independent lubricating systems. A mechanical lubricator serves the cylinders, pistons and connecting-rods, while there is a special system for the main bearings, which, it may be stated, are cooled from water spaces cast around them in the bedplate. In the bearing lubrication system the oil is lifted from a sump and delivered by the force pump to large reservoirs in the bearing caps. After lubricating the bearings it is automatically returned to the oil sump. As further safeguard, syphon wicks are fitted, so that should the pump fail, oil will continue to be supplied to the bearings for a considerable time.

From Fig. 3 it will be seen that the fuel pumps are grouped together in a single unit at the end of the engine bed-plate. There is a fuel pump for each cylinder, which is of the constant stroke pattern, the amount of fuel delivered to the atomiser being

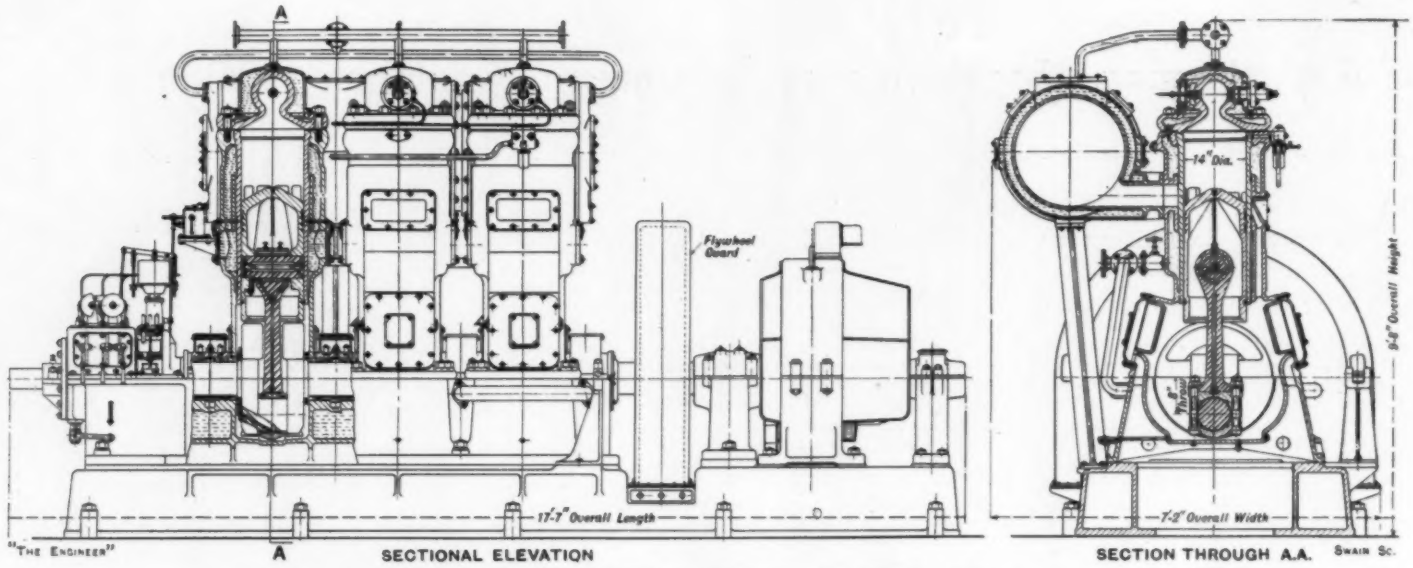


FIG. 3—125 KW MARINE AUXILIARY GENERATING SET—PETTERS (IPSWICH)

The outstanding feature of the Petter "C" type of engine is the use of a completely water-cooled combustion chamber, which is spherical in shape and communicates with the cylinder through a neck—approximately half the diameter of the combustion chamber sphere. With such a neck maximum turbulence is effected. A compression pressure of 300 lb. per square inch is employed, and it suffices to ignite the fuel, while the maximum pressure in the cylinders is kept down to about 450 lb. A fuel consumption of 0·43 lb. per B.H.P. hour is guaranteed.

Crank case compression has been retained and a simple device fitted on the crank webs catches any excess oil thrown from the reciprocating parts, and leads it away to the oil sump. The makers claim that

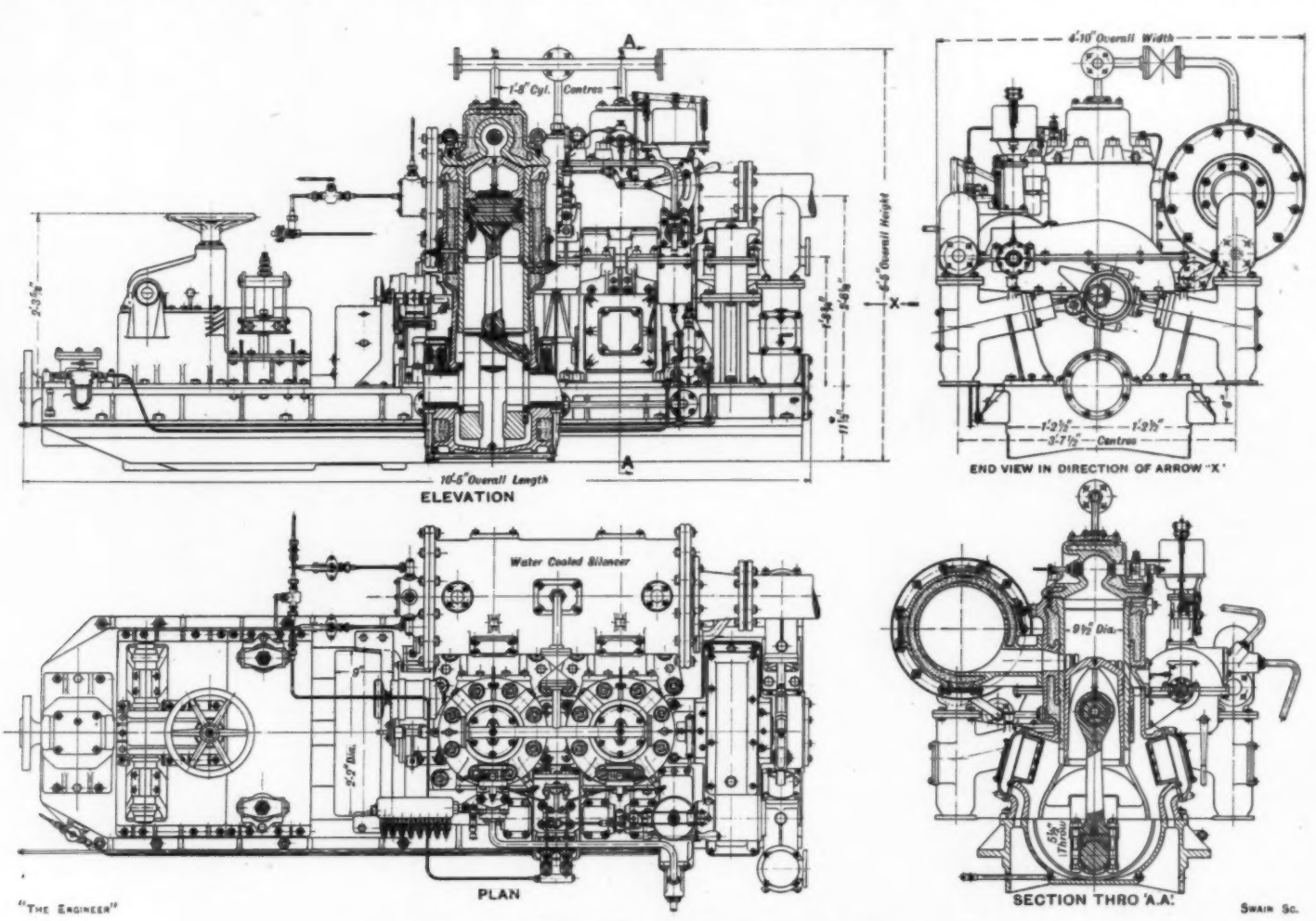


FIG. 4—55 B.H.P. MARINE PROPULSION SET—PETTERS (IPSWICH)

ignition of the fuel when starting from cold, electrically heated starting plugs are fitted in each combustion chamber. The 6-volt current for the elements is supplied from a small generator-battery set. The engine is set in motion by means of low-pressure compressed air, which acts on two cylinders. Admission of starting air is automatically timed by mecha-

nically operated valves arranged in a cover at the engine bed extension, and they are put into operation by a single hand lever.

Another engine which embodies the same principles of design as the one already described is the two-cylinder 55 B.H.P. marine propulsion unit. It has

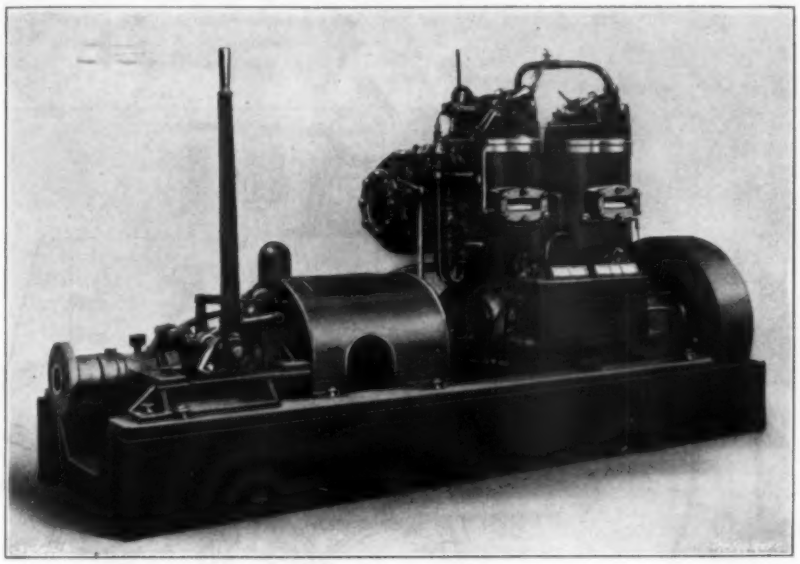


FIG. 5—24-28 H.P. MARINE PROPULSION SET—PETTERS, YEOVIL

two cylinders, with a bore of 9½in. and a stroke of 11in. and runs at a designed speed of 375 r.p.m. Drawings of the set are reproduced in Fig. 4. It will be seen that the bed-plate is bolted to longitudinal bearers, and is extended at the after end to take the reverse gear and the Michell thrust block. Bilge pumps and circulating water pumps are driven through reduction gearing from the main crank shaft of the engine. The pumps run at one-third the speed of the engine, and this feature is stated to add reliability to the installation. In the case of the marine engine, it will be seen that the fuel pumps are mounted on brackets at the sides of the cylinder jackets, and are driven from a cam shaft. Such an arrangement reduces the overall length of the set. The plate clutch and the reversing gear are of the builder's own design and manufacture, and, as our drawing shows, are robustly built and very compact. The clutch is designed to transmit the full power of the engine continuously, either in the ahead or the astern direction. Plates, of V section are used in the clutch, one-half of which are attached to the thrust shaft, and the other half to the gear-box drum. The clutch is engaged or

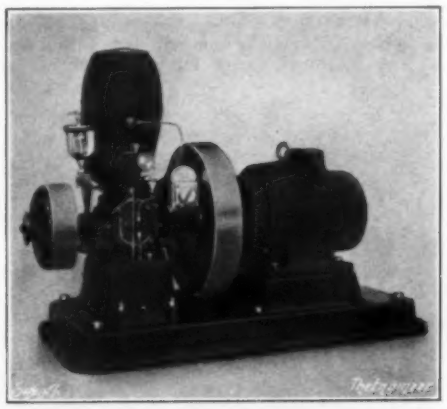


FIG. 6—1 KW LIGHTING SET—PETTERS, YEOVIL

released by the operating hand wheel, which transmits the movement through a bell crank lever and quadrant. The gear-box drum contains three pairs of intermediate gears. One of each pair meshes with the driving pinion, which is keyed to the engine shaft, and the other with the gear keyed to the propeller thrust shaft. When going in the "ahead" direction, both the gear-box and the clutch rotate together, and transmit the power of the engine directly to the propeller. For "astern" propulsion the control hand wheel is moved in the opposite direction. It releases the plate clutch, and brings into action toggle levers, actuating the cast steel Feredo-lined brake band, which encircles the gear-box drum. When this drum is fixed, the drive is transmitted through the intermediate gears, imparting a reverse direction of rotation to the propeller shaft. In the neutral or "stop" position the plate clutch and the brake band are both free, and the gear-box rotates with the engine crank shaft, while the propeller shaft is stationary. All the manœuvring operations above described are carried out by the single hand wheel. The gear-box is fitted with forced lubrication, which, however, is only required for long astern runs. The speed of the engine may be varied by a fuel control lever mounted on the governor column and the design of the gear is such that no matter at what speed the engine is run the governor speed control is maintained.

PETTERS, LTD., YEOVIL.

The two-stroke oil engines which are manufactured at the works of Petters, Ltd., of Yeovil, are represented by three typical examples of the firm's productions. They include a marine propulsion engine, complete with its reversing gear, and two direct-coupled ships lighting sets of small size. The marine engine, which we illustrate in Fig. 5, is one of the larger sizes of a series of six engines of this particular type, designed for outputs of from 5 to 42 S.H.P. It is a twin-cylinder model, and, as will be seen from our engraving, the fly-wheel is carried at the forward end. Each cylinder has a bore of 8in., with a stroke of 9in., and the standard rating of the unit is 24 to 28 B.H.P., when running at a normal speed of 525 r.p.m. The engine is mounted on a long cast iron bed-plate, which also carries the circulating and bilge pumps and the reversing gear. A gear of the "Langdon" or "Joes" type is usually fitted, which gives an overall length for the complete unit of about 7ft. 2½in. The width of the bed-plate is close upon 2ft. 3in. and the overall height of the engine from the under-side of the bed-plate is 2ft. 11in. A mechanically operated lubricator is fitted at the front of the two cylinders. For starting, compressed air is employed, and the engine is provided with an air starting valve, and also an air valve for charging the air receiver from the cylinders. An attachment for the firm's patented cold starter cartridge is fitted.

Another exhibit is a Petter direct-coupled oil-electric generator set designed for an output of 3 kW. The engine is a single-cylinder unit, with a bore of 4¼ and a stroke of 4½. It runs at a speed of 725 r.p.m., and is designed to work on paraffin or light fuel oil. Between the engine and the generator there is a heavy disc fly-wheel, which gives, with the two-cycle operation, a low cycle variation. This engine is also fitted with the firm's cold starting device, and a half compressor valve is provided for use during the starting operations. In this series of engines six sizes are made, with outputs varying from 3 kilowatts up to 24 kilowatts.

The third engine exhibited on this stand which we illustrate in Fig. 6, is a 1 kW direct-coupled lighting set with a 1½ B.H.P. engine designed to work on petrol or paraffin fuel. This model has a high-tension magneto ignition, and it is complete with a belt-driven water-circulating pump. It runs at a designed speed of 1000 r.p.m., and the cylinder has a bore of 2⅞in., with a stroke of 3in.

RUSTON AND HORNSBY, LTD.

The predominating exhibit on the stand of Ruston-Hornsby, Ltd., of Lincoln, is the firm's new five-cylinder marine auxiliary generator set. A similar unit was described and illustrated in THE ENGINEER of July 1st. In Fig. 7 a general view of the back of the engine is given, with the generator in the foreground, while in Fig. 8 we reproduce a cross section through one cylinder, a section showing the fuel pump and auxiliary pump drives, and an end view. The engine has a designed output of 275 B.H.P., when running at 300 r.p.m., and it has a bore of 12in. with a 17½in. stroke. It is coupled to a 165 kW, 220-volt, direct-current generator, made by the General Electric Company, Ltd., of Witton. As will be seen from our illustration, the generator base plate is bolted directly to the engine bed-plate. A common width has been adopted for both base plates, the extra width for the fly-wheel cover and the magnet frame feet being obtained by using slightly over-hanging brackets.

The first section in Fig. 8 shows the deep box type bed-plate, with its central oil sump. At the end of the engine—a view of which is reproduced in the same drawing—the oil sump forms a deep tank, from which the lubricating oil pump draws its supply. Baffles are fitted to ensure that even with a slight movement of the ship, the suction branch is always covered. Referring again to the cylinder section, Fig. 8, attention may be drawn to the very large inspection doors, which are nearly rectangular in

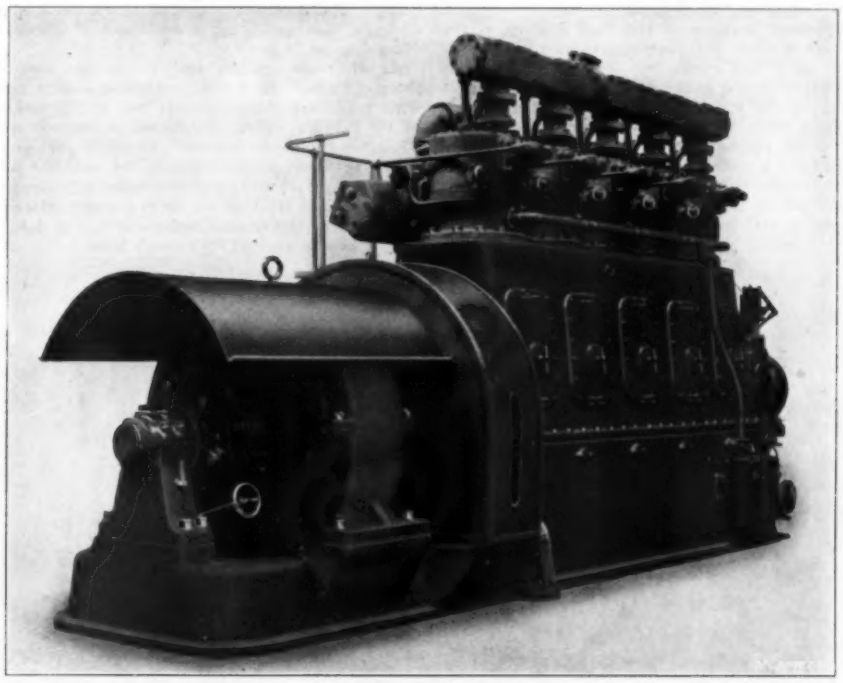


FIG. 7—165 KW MARINE AUXILIARY LIGHTING SET—RUSTON

shape. They give easy access to the main bearings and the reciprocating parts. For the purpose of easy dismantling a two-piece piston is employed, the piston head being secured to the skirt by four substantial bolts. The gudgeon pin is of the floating type, and it is lubricated by oil which passes from the main bearings through the connecting-rod up to the top end bearing. As the liners are lubricated by the splash on the piston skirts, the lower end of the piston is provided with an oil scraper ring.

The valves do not differ from the standard Ruston Hornsby practice, but in the type of engine we are describing the cam shaft is completely enclosed, and cams in a bath of oil.

Fig. 9 clearly shows the sequence of operations

employed when it is desired to dismantle a piston and withdraw it, together with the connecting-rod and the bottom end bearing, through the crank case inspection doors. The drawings illustrate the patented two-fulcrum cradle, which receives the palm of the connecting-rod, and also the methods of supporting the piston head and the piston skirt during this operation. As indicating the comparative simplicity of the dismantling operation, we may say that the makers inform us that the complete reciprocating gear of pumps. The engine is fitted with automatic air starting valves on each cylinder, the starting air being controlled from a main valve on the driving platform, which runs the full length of the front of the cam. As the end view in Fig. 8 shows the speed control and fuel pump control levers are neatly arranged at the end of the engine, so that they can be operated by the attendant from the floor level. Recent trials, which extended over a week, showed, we understand, that a fuel consumption of 0·62 lb. of oil per kW hour, output up to 6000 gallons per minute, is also exhibited. It can be arranged either for a belt drive or a direct coupled drive, and is self-regulating when running at constant speed.

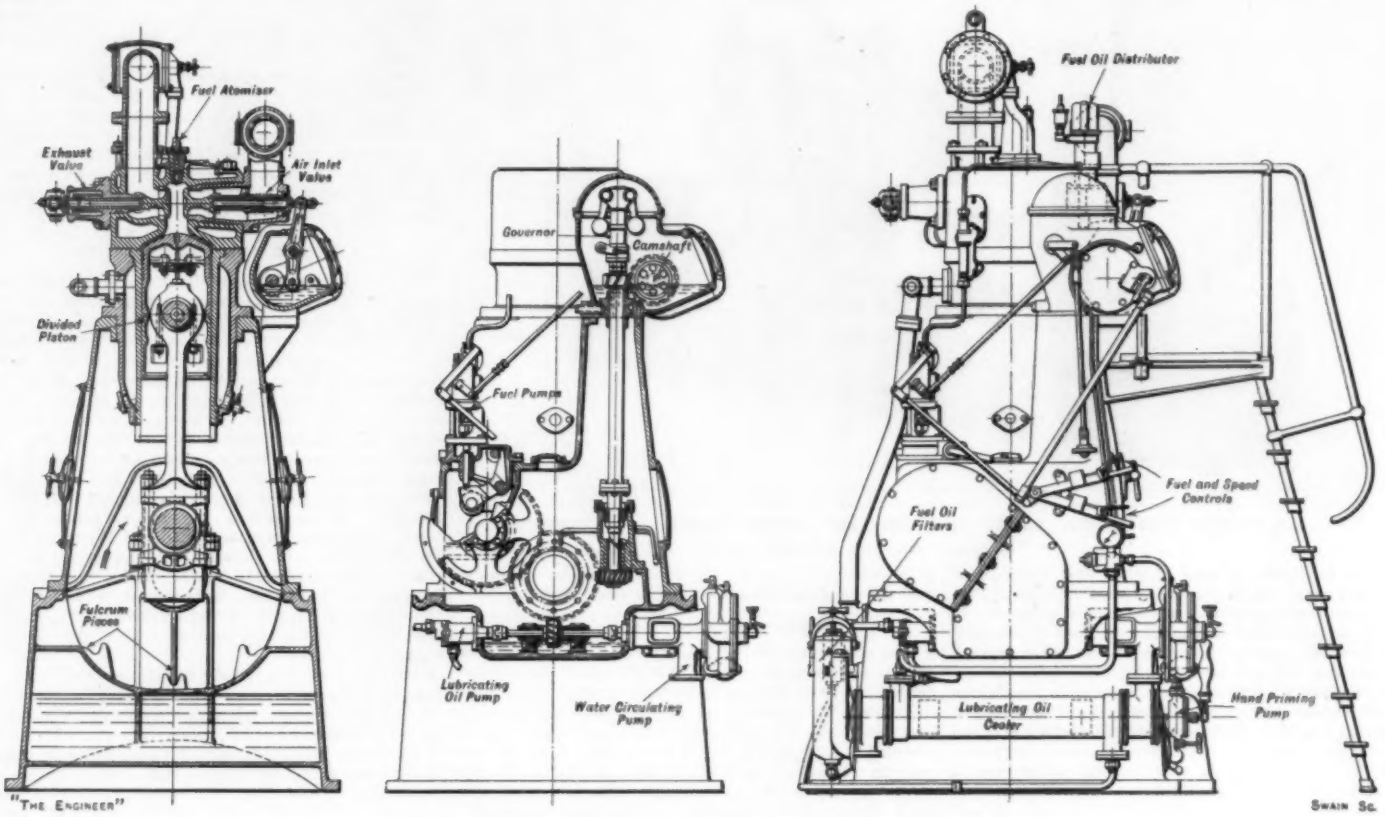


FIG. 8—CROSS-SECTIONS AND END VIEW OF RUSTON OIL ENGINE

any given cylinder can be withdrawn for inspection within half an hour.

An important feature of the fuel system is the employment of a fuel distributor, in place of a separate pump for each fuel atomiser. There are two fuel pumps, and, as shown in the centre section of Fig. 8, they are driven by spur gearing from the crank shaft. Both pumps have a common discharge and the oil passes from the discharge pipe to the fuel distributor. This consists of a reciprocating plunger with five sets of inlet and outlet ports, which serve to direct the fuel oil to the various fuel atomisers. Uniformity of oil fuel supply is assisted by making all delivery pipes of the same length.

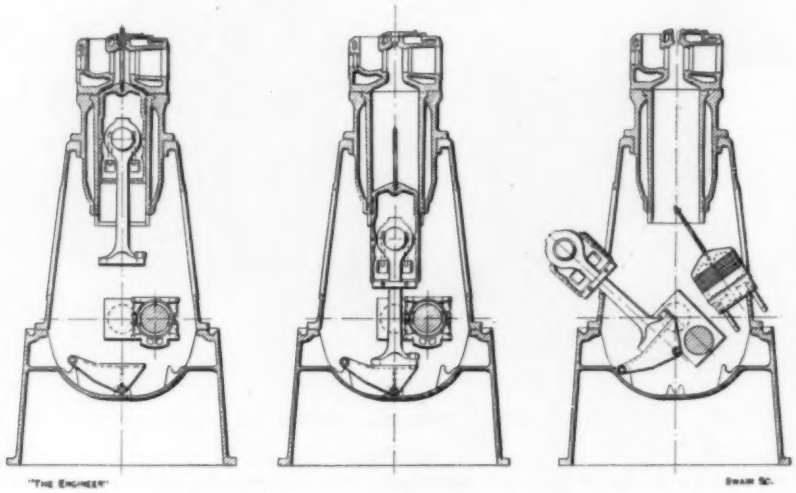


FIG. 9—METHOD OF WITHDRAWING RUSTON PISTON

As the engine works on the airless injection system, special means are employed to strain the fuel. A pair of change-over filters are fitted at the back of the engine—see Fig. 7—so that either filter can be cleaned while the engine is running. There are also strainers in the fuel pump circuit, and individual filters in the pipes leading from the distributor to the fuel atomisers. The drawings we reproduce also show the vertical shaft and governor drive and the cross shaft drive for the lubricating and circulating water

corresponding to, say, 0·41 lb. of fuel per B.H.P. hour, is obtained. The weight of the set without the dynamo, but including a fly-wheel of about 6ft. in diameter, is 34 tons.

Another outstanding exhibit on this stand is the three-cylinder oil engine propulsion set, complete with reversing clutch, which has a designed output of 90 B.H.P. when running at a normal speed of 350 revolutions per minute. The cylinders each have a bore of 9½in., with a 15in. stroke, and the engine is fitted with a neat type of reversing gear designed by the makers of the engine. It is accommodated on an extension of the engine bed-plate and is designed so that it can be worked by a single lever.

This firm is also exhibiting some self-regulating centrifugal pumps for drainage, and high-level pumping installations. There is a 3in. Ruston pump, coupled direct to a "Ransome" motor and designed for outputs up to 280 gallons per minute and heads up to 80ft. A point of interest is the adjustable delivery branch which can be swivelled into any one of eight different positions, thus making the pump adaptable for work in difficult situations. A 14in. Ruston pump for heads up to 35ft. and capable of an

The Aster Engineering Company (1913), Ltd.

On the stand of the Aster Engineering Company (1913), Ltd., of Wembley, Middlesex, there are as many as eight petrol and paraffin engines, three typical examples of which we illustrate in Figs. 10, 11, and 12. The first of these is a handy little self-contained pumping set driven by a petrol engine. The engine is of 2 brake horse-power, and is directly connected with a pump carried by a hood attached to the side of the crank case. It will be noticed that this hood gives plenty of room for repacking the stuffing-box. The pump exhibited is capable of delivering 3500 gallons an hour against a head of 70ft., or 500 gallons against 95ft. total head. Fig. 11 represents a marine set with a self-contained reversing gear, for small launches or auxiliary work. It is of 10 horse-power, and it has four cylinders, with a bore of 65 mm. and a stroke of 110 mm. The normal

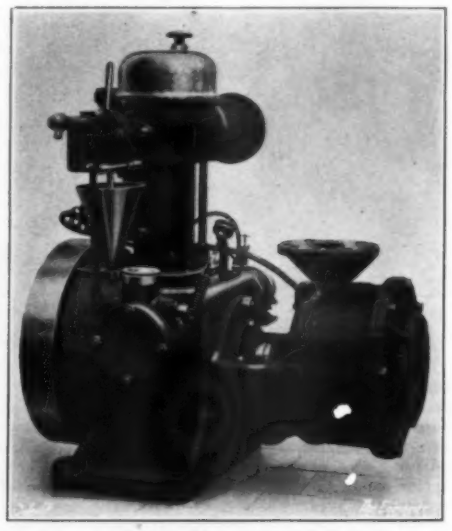


FIG. 10—2 B.H.P. PUMPING SET—ASTER

running speed is 1200 r.p.m. The cylinder head is detachable and contains the overhead valves, which are operated by totally enclosed gear. The cam shaft and magneto are driven by a silent toothed chain enclosed in an oil-tight case. The fly-wheel and reversing gear are enclosed by an aluminium casing, bolted on to the end of the crank chamber, which is extended upward to support the starting handle. The reversing gear is of the epicyclic type,

with a plate clutch and is controlled by a single handle which gives ahead, astern and neutral positions. The controls for the carburetter and magneto are also mounted on this casing, so that with the steering wheel or tiller in a handy position the boat can be easily handled by one man without moving. These engines are usually supplied with a propeller 14in. in diameter.

The little set shown in Fig. 12 is intended for country house lighting and similar services, and is of the semi-automatic type. A very similar engine by the same makers has already been described in THE

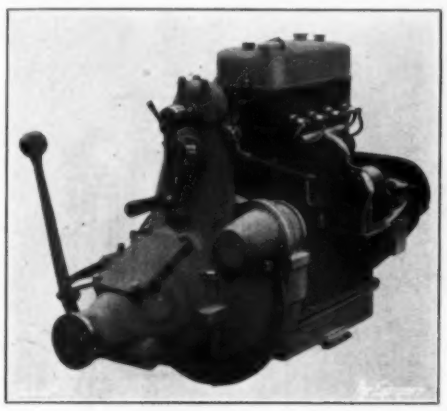


FIG. 11—10 H.P. MARINE SET—ASTER

ENGINEER, but in that case the cylinder was air cooled. In the engine exhibited a water jacket is employed. The capacity of the machine is 1 kilowatt, and the dynamo may be wound for either 25 or 50 volts. These sets are run in conjunction with a storage battery, from which the current necessary for ignition is obtained through a coil. The battery is of such a size that it will carry all ordinary lighting loads by itself, and the engine is only started up at any convenient time for recharging the battery. The starting is effected by closing a switch which makes the dynamo motor the engine round, and as soon as it is up to speed the dynamo starts to generate current, and continues until the battery is fully recharged, when it is cut out. The engine can, however, be run for recharging while the lamps are on, as no excess voltage can be generated. On the same stand there are also a 5 B.H.P. two-cylinder engine coupled directly with a centrifugal pump, a 10 B.H.P. four-cylinder portable generating set, a 15–17 B.H.P. two-cylinder generating set, another one of 25 to 30 B.H.P. for running on petrol or paraffin, and a

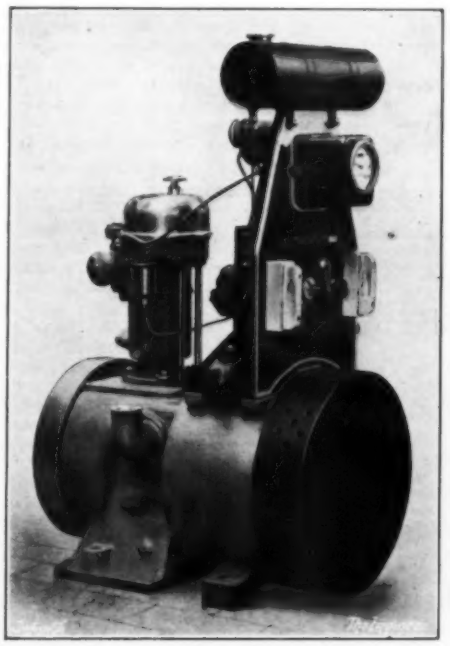


FIG. 12—1 KW AUTOMATIC LIGHTING SET—ASTER

50 B.H.P. paraffin set. There are also examples of the Anthony boiler feed regulators, which we have already described, together with some donkey pumps.

NORRIS, HENTY AND GARDNERS, LTD.

Among the comparatively large oil engines are the twin-screw marine set, shown by Norris, Henty and Gardners, Ltd., of Patricroft, one of which is illustrated by Fig. 13. As will be seen, it is a six-cylinder engine and has a bore of 11½in. by 12½in. It runs at a speed of 320 revolutions per minute. The clutch and reversing gear are mounted on an extension of the bed-plate; there are two plunger pumps, one for the circulating water and the other for pumping out the bilges. The lubrication is forced throughout, and there is an air compressor for providing starting air. When starting from cold the electric igniting device—shown in Fig. 14—is employed to explode the first few charges, but ignition is, of course, automatic when the engine is running. As will be seen,

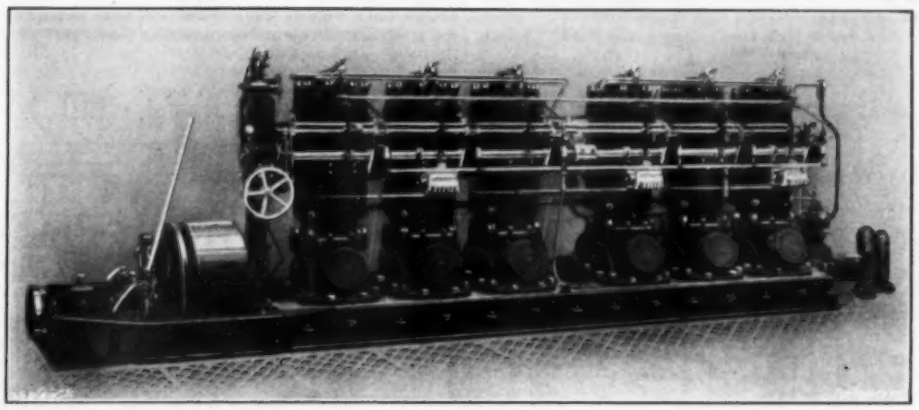


FIG. 13—ONE UNIT OF SIX-CYLINDER, TWIN-SCREW MARINE SET—NORRIS, HENTY

the device, a coil of wire embedded in refractory material, heated by a 12 volt current to a red heat. The spray of fuel oil is projected against this plug and ignites immediately. After the engine has got under way the sprayer nozzle is turned round by hand, so that the jet is projected across the combustion chamber, clear of the plug, which is consequently saved from deterioration while the engine

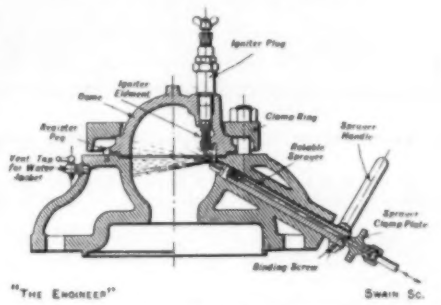


FIG. 14—CYLINDER HEAD AND STARTING IGNITER

is running. The igniter element can nevertheless be quite easily renewed when it is worn out.

Another special feature of these engines is the arrangement of the small end of the connecting rod—see Fig. 16—which needs very little description. As will be seen the connecting rod embraces the gudgeon pin loosely, and the pressure is transmitted through a hardened steel pad, while an adjustable abutment is provided to carry the weight of the rod when the engine is being overhauled. It does not touch the pin when running. The result of this arrangement, which is made under licence from the Kromhout Company, is a pure rolling action of the two parts and all lubrication troubles are avoided. The gudgeon pin can be turned round to provide four wearing faces. At the first glance it might appear that there is nothing to determine the position of the rod relative to the centre of the gudgeon pin. This is quite true when the engine is at rest; but a little reflection will suffice to show that, as soon as the engine begins to turn, the rod automatically adjusts itself so that the line of rolling contact is always in the same place for any one assigned angular position of the rod. In other language, as soon as the engine begins to turn, the rod automatically locates itself so that the pad rolls to and fro through an equal distance on either side of the centre line of the rod.

The engines exhibited are fitted with a new variable speed governor by means of which they are under the complete control of the governor throughout the range, from full speed down to ¾ (or less) of full speed when driving the propellor. In addition to

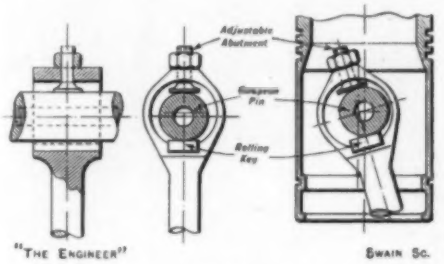


FIG. 16—ROLLING SMALL END

this, a hand control lever is fitted which enables the speed to be instantaneously changed while manœuvring. This twin set consists of port and starboard engines (left and right-hand), and when installed the motion work and manœuvring gear are arranged in one alley between the engines. These engines are built in many sizes, from 7 to 500 B.H.P. (one, two, three, four and six-cylinders). They use the cheapest grades of fuel economically, and are extremely economical in their use of lubricating oil.

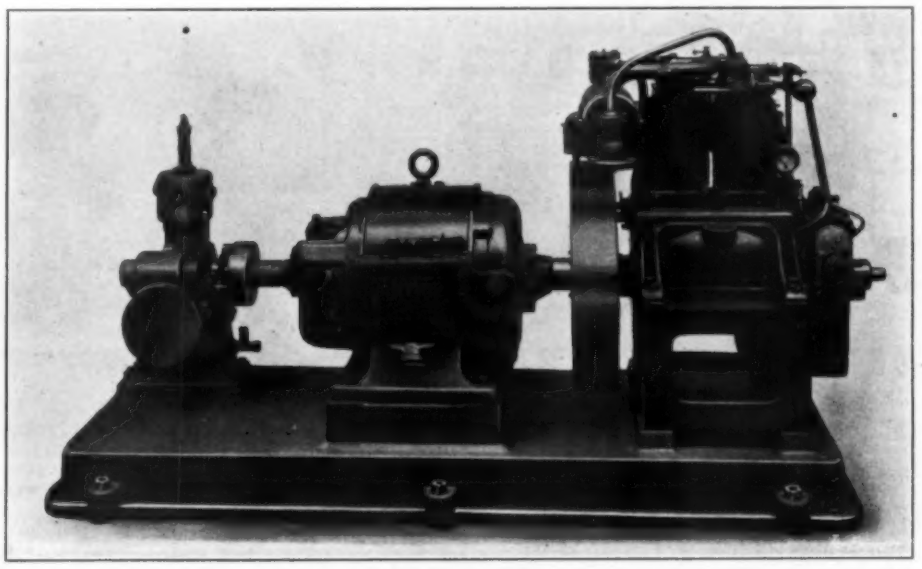


FIG. 15—12 B.H.P. GENERATING AND COMPRESSING SET—NORRIS, HENTY

The combined set—shown in Fig. 15—by the same makers, is a two-cylinder 12 B.H.P. petrol-paraffin engine coupled with a dynamo and air compressor in line, mounted on a common bed-plate. These units have been developed as stand-by sets, where it may be necessary to provide compressed air for

starting the main set in the event of the stored air being lost through inadvertance, and for lighting the engine-room and ship in port, when the main sets are shut down. On this stand there are, besides the engines which we illustrate, an 18 B.H.P. three-cylinder, marine type petrol-paraffin engine, with its reverse gear, which is fitted with two float-feed chambers, with a change over cock, so that either class of fuel can be used. The engine is force-lubricated, is equipped with a centrifugal throttle governor, and has a water-jacketted exhaust manifold. Among the horizontal engines on this stand there is one of from 29 to 31 B.H.P., running at 250 revolutions per minute, which is of the four-stroke type, and can be started immediately from cold without any external aid, together with a 7-8 B.H.P. engine of similar general design intended for hand starting.

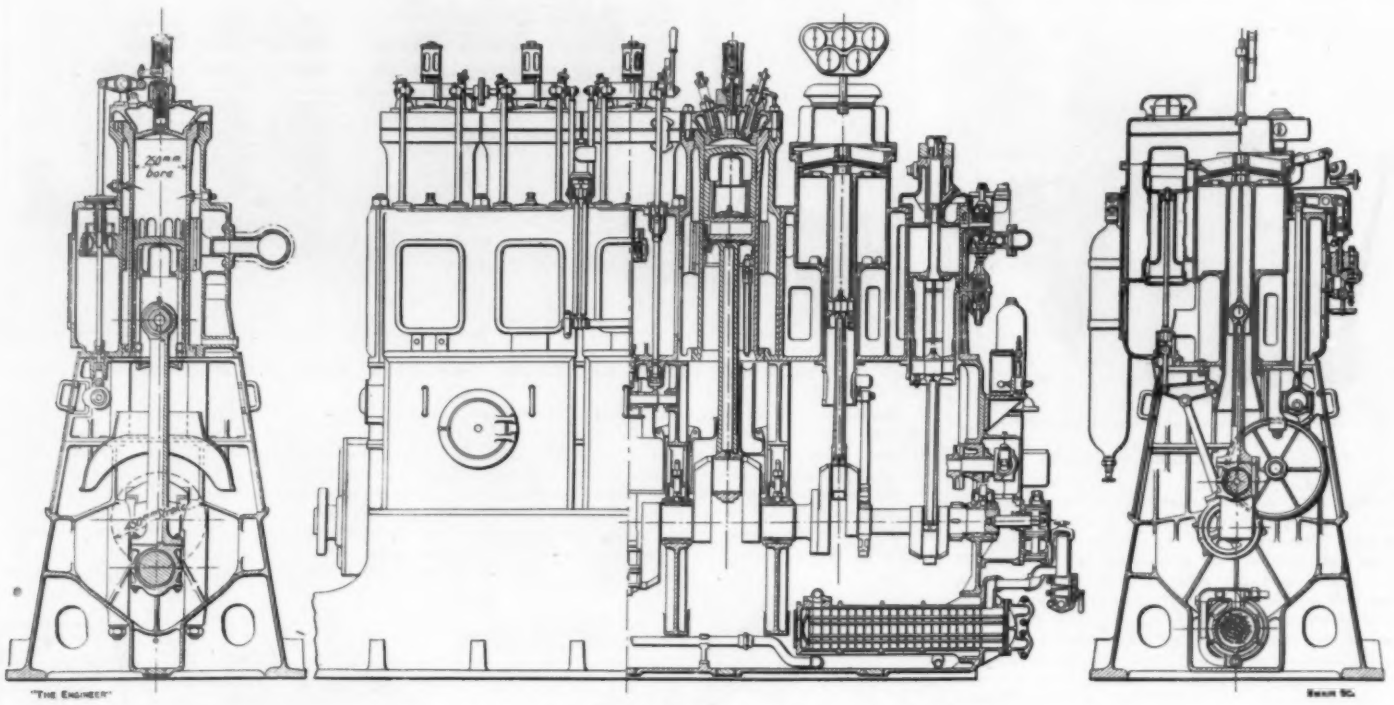


FIG. 17—240 B.H.P. MARINE OIL ENGINE—FIAT BRITISH AUXILIARIES

Fiat British Auxiliaries, Ltd.

The marine auxiliary generator set, which is to be seen on the stand of Fiat British Auxiliaries, Ltd., of 43, Albemarle-street, London, W. 1, is of particular interest, as it shows the type of engine which is to be be built at that firm's newly opened works at Helen-

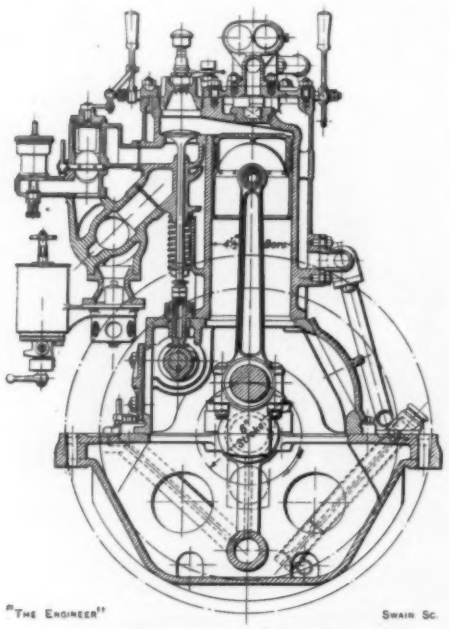


FIG. 18—CROSS-SECTION OF PARSONS ENGINE

street, Govan, Glasgow. We learn that orders for over fifteen sets of auxiliary engines, as well as a series of eight high-pressure compressors, are now in hand, and that special machine tools have been installed for this new work. In the accompanying drawing, Fig. 17, we show a sectional elevation of the engine, with cross sections through one of the main cylinders, and also the scavenge pumps and the air compressor. The engine is designed to develop 240 B.H.P. when running at a normal speed of 270 r.p.m., and it has four cylinders with a bore of 250 mm. (9¾in.) and a stroke of 450 mm. (17¾in.). It is coupled directly to a 150-kW, 220-volt, direct-current generator made by the General Electric Company, Ltd., who, we understand, are interested in making this a combined exhibit. An inspection of the drawing will show some noteworthy features in engine design. Attention may be called to the manner in which the cylinder covers are dropped within the cylinder liners for a short distance, so that a comparatively thin and well-cooled liner wall at the combustion zone is obtained. Such an arrangement removes the thick part of the liner from close proximity to the combustion space, and thereby reduces the likelihood of the liner being subjected to undue heat stresses.

For this size of engine an oil-cooled trunk type of piston with a slightly domed crown has been adopted, and the simple shape of the piston head may be noted. The cylinder covers are made in cast steel, and they, too, are of symmetrical form, with thin walls, giving efficient cooling. Three valves are fitted in each cylinder cover, namely, a central fuel valve with a starting valve and a safety valve arranged on either side of the fuel valve along the longitudinal axis of the engine. The design of the cover is such that by removing the cylinder cover bolts and lifting away the cover and all its gear, a piston can be withdrawn in about 20 minutes.

Attention may be called to the exhaust and scavenging ports. They are of equal length and it will be seen that no provision is made for supercharging by means of auxiliary ports. The makers inform us that according to experiments which they have carried out, the increased length of lost stroke quite counterbalances any gain which may be obtained by a slight increase of the scavenge pressure after the main scavenge ports have been covered by the piston, that may be obtained by using auxiliary ports. As in other engines of the Fiat type, non-return valves are fitted on the scavenge air belt, so that any tendency for the exhaust gases to gain access to the scavenge air spaces when the air ports are first uncovered, is avoided. In the engine we are describing use is made of a cam-operated piston valve, but we understand that for other designs automatic valves have been found to be quite satisfactory, and that they will be adopted in later engines. It will be noticed that the cam shaft is housed within the crank case, where it receives copious lubrication and runs extremely quietly. It is driven from the crank shaft by spur gearing. We may remark on the ample inspection doors which give easy access to the reciprocating parts and the main bearings of the engine.

The crank shaft bearings and the running parts are arranged for forced lubrication, and the oil is circulated by a pump of the gear type, which serves both the oil cooling and the piston cooling systems. The oil cooler for the latter service is arranged within the bed-plate, and is clearly shown in the drawing. A scavenge air pump of the reciprocating type is used, and the inlet and outlet valves are controlled by a piston valve of simple design, which is driven by excentrics from the crank shaft. The fuel pumps are driven in a similar manner. We may remark on the neat arrangement of the injection air bottle at the back of the engine and the gauge board on a prominent place above the governor and scavenge air pump. The set has an overall length of approximately 16ft. 9in., with an engine width of 4ft. 7in., and a width over the generator base plate of nearly 7ft. The crank shaft runs at a height of about 2ft. 7½in. above the underside of the bed-plate, and the total height of the set is close upon 10ft. The total weight of the unit, including the generator and fly-wheel, is, we are informed, a little over 21½ tons, of which approximately 7½ tons must be allowed for the weight of the generator.

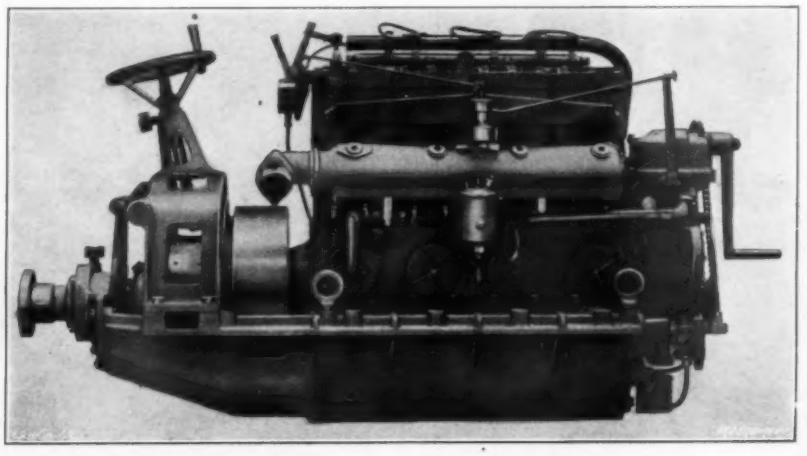


FIG. 19—28-32 H.P. MARINE PROPULSION SET—PARSONS

The Parsons Oil Engine Company, Ltd.

Representative types of marine and industrial oil and petrol engines are exhibited on the stand of the Parsons Oil Engine Company, Ltd., of Southampton. We illustrate in Fig. 19 one of the latest type Parsons marine oil engines, which is designed to develop 28 B.H.P. on paraffin and 32 B.H.P. on petrol, when running at the designed speed of 900 to 950 r.p.m. It is a four-cylinder unit, with a bore of 4½in. and a

stroke of 6in., and is complete with reversing gear which is carried on an extension of the crank chamber casting. The drawing, Fig. 18, which is a cross section through one of the cylinders, illustrates some of the features of the new design. A deep bed-plate of robust construction is provided and the lubricating oil ducts are cast in the bed-plate and drilled out, so that there is direct connection to all parts which require lubrication, and no outside oil connections are necessary. The crank chamber serves to house the cam shaft, and it is provided with large inspection doors through which access is given to the main bearings, and through which the pistons and connecting-rods may be withdrawn. The liner and

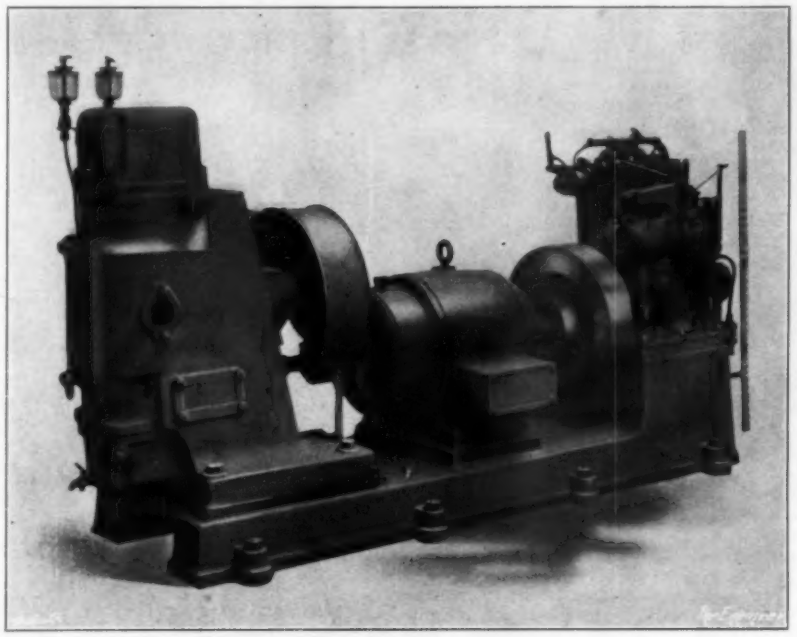


FIG. 20—AUXILIARY LIGHTING AND COMPRESSING SET—PARSONS

cylinder casing form a single casting, and a removable cover on the cylinder head gives access to the internal water spaces for examination and cleaning. The valves may also be withdrawn from above by removing the valve covers. All controls are neatly grouped at the after end of the engine. At the forward end is the governor, and the magneto and auxiliary pump drives. A starting handle, with a chain drive, is fitted. Our illustration, Fig. 19, shows the standard Parsons type reversing gear, with a single hand wheel, controlling the ahead, astern and neutral positions. The gear also includes a thrust bearing and a coupling for the propeller shaft, and as exhibited a short length of propeller shafting with a standard propeller is included. This standard type of motor is built in sizes of two, three, six and eight-cylinder units, and a "straight eight" engine of this pattern is also exhibited.

As showing the type of work for which such motors are intended, we may say that two four-cylinder paraffin engines of the design we illustrate were recently supplied to Elder, Dempster and Co., Ltd., for installation in a general service passenger and cargo launch, which will be employed in the firm's West African coastal service. The boat, which is named the King Tom, was built by J. Crichton and Co., Ltd., of Chester, and it has the following principal dimensions:—Length, 57ft.; beam, 14ft.; draught, 3ft. 3in. She is designed to carry a load of 10 tons, and the twin-screw machinery gives her a designed speed of 8½ knots.

An example of a larger type of engine is the four-cylinder marine set, with a designed output of 55 B.H.P. on paraffin and 65 B.H.P. on petrol, when running at 750 to 800 revolutions. The cylinders of this engine have a bore of 6½in., with a stroke of 8in. and for larger outputs 6¾in. bore cylinders can be supplied. All the main bearings of this size of unit are cooled by means of water-filled passages cast within the bed-plate. A six-cylinder and an eight-cylinder engine are also manufactured in this series, which allows a maximum output of 140 B.H.P. in the marine type of engine and 100 kW for engines driving generators.

An interesting example of a ship's auxiliary set is that shown in Fig. 20, which is similar to one exhibited at Olympia. It comprises a standard two-cylinder 16 B.H.P. Parsons engine, which is mounted on a combination bed-plate and drives an 8 kW 220-volt, compound-wound, Laurence Scott generator of the "Deluge" type. The generator shaft is extended at the commutator end, and is geared to a Reavell "Duplex" two-stage air compressor. As the engine and generator run at 900 revolutions, the compressor is geared down to run at its designed speed of 400 r.p.m. At this speed it has a displacement of 15 cubic feet of air, and will deliver air at a pressure of 1000 lb. for charging air bottles. Six sets of this type were recently built for Wm. Doxford and Sons, Ltd., for installation on motor vessels of the Silver Line. The engraving, Fig. 20, shows one of these units, which is generally similar to the set exhibited at Olympia.

FILMA OIL BURNERS, LTD.

On the stand of Filma Oil Burners, Ltd., of 68, Victoria-street, S.W. 1, examples of oil burning apparatus suitable for donkey boilers, galley ranges, central heating boilers, and so forth, are exhibited. The Filma oil burner is distinguished by the fact that it emits the fuel oil not in a jet giving an intense and concentrated flame, but as a thin film of oil which is disintegrated into a widely diffused cloud. A Filma burner designed for use in conjunction with steam or compressed air is illustrated in Fig. 21. The action will be understood from the section given in Fig. 22. The oil is supplied to the top compartment of the burner. The floor of this compartment slopes downwards, and widens in width, with the result that the oil when it reaches the edge is in the form of an attenuated film. Reaching the edge, the oil falls over a lip which is scalloped with the object of preserving the oil as a film and preventing it from concentrating into a few narrow streams by reason of its surface tension. The lower compartment of the burner is supplied with steam or compressed air at about 20 lb. pressure. This steam or air issues from two rows of fine holes just below the lip. The two lines of holes are drilled at about right angles to each other, so that the streams issuing from them may converge at a point slightly

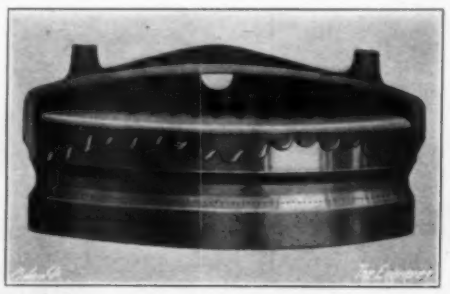


FIG. 21—FILMA OIL BURNER

in advance of the lip. The falling film of oil is met first by the upper streams of steam or air, and is broken up into a fine spray. The mixture of oil and steam or air is then carried forward to the line of intersection of the two sets of streams. The turbulence at this point causes the oil to be further atomised, and to pass forward as a cloud principally under the influence of the natural draught of the furnace. This cloud floats forward and fills the furnace with a wide turbulent mass of flame. As compared with the intense concentrated flame from the usual jet type of burner, the Filma burner is claimed to give a flame that is much less destructive to the furnace brickwork, and which gives the maximum assurance that the fuel will be completely burned before it passes beyond the furnace.

As there is an entire absence of small passageways for the oil, it is quite unnecessary, the makers state, to filter the oil or to preheat it. Other features claimed for the burner are its simplicity, its silent working and the absence of vibration. The burner, it is added, ensures a high temperature combined with a very low velocity, conditions which combine to ensure the maximum proportion of the heat being transmitted by radiation.

The apparatus as described is being shown applied to a donkey boiler. The external appearance of the burner and its housing is illustrated in Fig. 23. The burner and housing are mounted to swing outwards on steam and oil-tight swivel fittings, and when

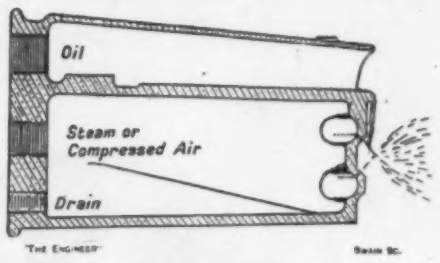


FIG. 22—SECTION THROUGH FILMA BURNER

swung out enable the attendant to examine the burner and the interior of the furnace. The housing is secured by a trip catch, which cannot open except when required. The piping system includes an arrangement for the supply of warm free-running oil to permit the lighting up operation to be conducted with the production of smoke.

A second exhibit on the company's stand is a Filma burner arranged for operating with a fan blast instead of with steam or compressed air. The lower pressure of the fan blast entails, as shown in Fig. 24, the use of a modified form of scalloped lip, while the air, instead of being delivered through fine holes, is emitted

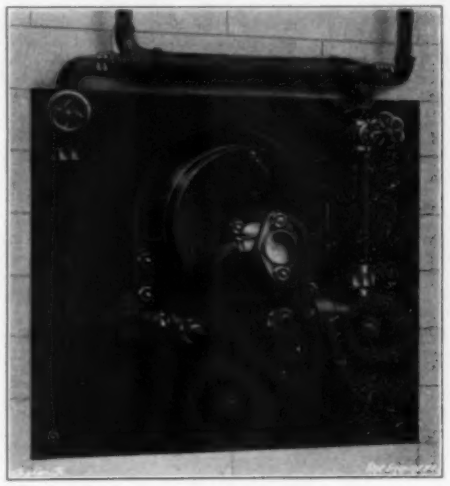


FIG. 23—BURNER AND HOUSING—FILMA

past two sets of "shark's teeth," which give the same convergent action. This burner, it is claimed, gives the high temperature radiant heat qualities of the oil fuel flame combined with the volume and low velocity of the producer gas flame. The fan blast burner is particularly adapted to furnaces in which articles are fired, for it avoids the risk of locally overheating them or of causing local damage to the brickwork. This form of burner is made as a complete portable unit, consisting of the burner itself, a motor-driven fan, a starter for the motor, an oil connection and air and oil valves, the whole being mounted on a two-wheel truck. In this form the

FIG. 24—FAN DRAUGHT BURNER—FILMA

burner is suitable for lighting up large furnaces from the cold.

For firing central heating boilers, baking ovens, galley ranges, greenhouses, and so forth, the company is exhibiting the type of apparatus shown in Fig. 25. This unit is intended to work in conjunction with a Filma oil burner designed to operate with low-pressure compressed air. It is provided with a base forming a tank capable of holding 15 gallons of fuel oil. The tank has an oil level indicator at the front and a hand-operated refilling pump at one end. On top of the tank there is an electric motor of ¼ H.P., which

is coupled, beneath a perforated guard, to an air compressor delivering air at from 1½ lb. to 3 lb. pressure. The amount of air delivered by the compressor to the burner is controlled by a thermostat. The air pressure is admitted to the tank and serves to raise the oil therefrom to the burner. Hence the thermostat regulates not only the amount of air, but also the amount of oil delivered to the burner, and consequently automatically governs the intensity of the flame, and the temperature of the circulating water or oven or other apparatus to which the unit is applied.

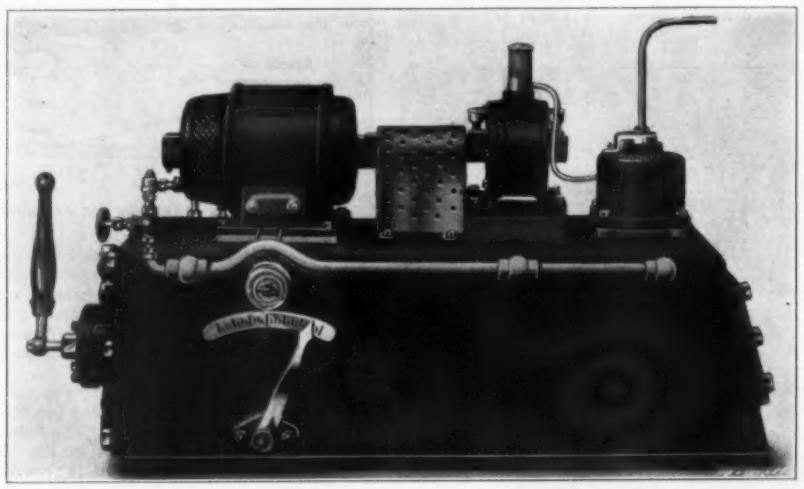


FIG. 25—SELF-CONTAINED OIL BURNER UNIT—FILMA

The thermostat permits the preserved temperature to be varied by any desired amount. The whole apparatus is under the control of a switch in the motor circuit.

THE B.E.N. PATENTS, LTD.

An interesting display of portable and other electric labour-saving tools for a variety of purposes is being made by the B.E.N. Patents, Ltd., of 92, Tottenham Court-road, W. 1. In addition to electric drills, the exhibits include portable electric hand saws, a hand planer, mortising machine, saw and sanding machine, sand-papering machine and cloth cutters.

The portable electric saws are of the type illustrated in Fig. 26. The motor is of the series-wound, universal type, and can be operated off a lighting socket. It drives a saw 6in., 8in. or 10in. in diameter, according to the size of the machine, at a speed of 3600, 1500 or 1500 r.p.m. respectively. The tool can be used either for ripping or cross-cutting, and is suitable for cutting, besides wood, many other materials, including even light gauge soft metal. The motor drives the saw through gearing, and is controlled from a switch situated in the handle. A dust shield, which can easily be removed without the use of a tool surrounds the upper half of the blade. A depth gauge is combined with the slipper plate. When the tool is not in use the saw is withdrawn and held above the slipper plate, in which position it is adequately protected against accidental damage. It is claimed that this tool can cut through timber up to 3⅜in. thick at a rate thirty times as fast as is possible by hand.

The portable electric planer, known as the "Alta" power plane, is illustrated in Fig. 27. The motor is again of the universal type, and can be connected to a lighting socket. The frame is made of aluminium, and the total weight of the tool is 25 lb. Dustproof ball bearings are provided for the cutter shaft. The cutter itself is equipped with high-speed steel blades, which can be readily removed for sharpening. At the front of the body there is an indicator dial, which operates the adjusting screw and shows the depth of cut. The cutter can be raised or lowered while the cut is being taken, a feature which makes it possible to smooth out humps or to take a taper cut. The machine will plane any width up to 2⅛in., and can take a cut varying from 0in. to ⅛in. in depth.

The universal saw and sanding machine—illustrated in Fig. 29—is suitable for attachment to a bench. It is driven by a quarter horse-power motor enclosed within the base casting. The motor runs at 1800 r.p.m., and drives by belt a 6in. saw running at 3600 r.p.m. The saw table measures 12in. by 10in., and can be tilted through any angle up to 45 deg. The motor spindle is extended, and at one end carries a 6in. by ½in. grinding wheel, which is fitted with a wheel guard and a tool rest. At the other end the motor spindle carries an 8in. garnet disc sander, in conjunction with which there is provided an adjustable 8in. by 6in. table. The saw table is fitted with a guard, a protractor guide and a fence, and can be raised and lowered as well as tilted. Cuts up to 1½in. deep can be taken with the standard 6in. saw. The total weight of the machine is approximately 82 lb.

The portable sanding machine exhibited by the company—see Fig. 28—is that made by the Porter-Cable Machine Company, of Syracuse, New York. This machine weighs only 13 lb., and is driven by a one-third horse-power universal motor. It is operated after the manner of a hand plane. The body is of aluminium, as are the two rollers over which the sanding belt passes. The rear roller is driven by the motor through worm gearing. Behind this roller, just below the handle, is a roller guide the height of which can readily be adjusted to vary the amount of belt surface brought into contact with the work. Between the two belt rollers there is a felt covered pad, flat or curved to suit the work. In order that flat surfaces without waves may be produced, it is arranged that the sanding is done only beneath the pad, the belt beneath the rollers standing clear of the work surface. The belt rollers are 2½in. in diameter, and by tilting the machine the front roller may be used to sand interior curves of that diameter

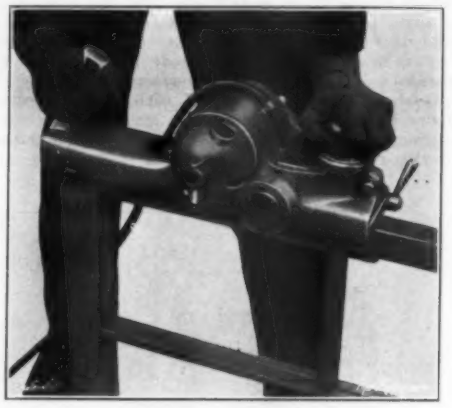


FIG. 27—POWER PLANER—B.E.N. PATENTS

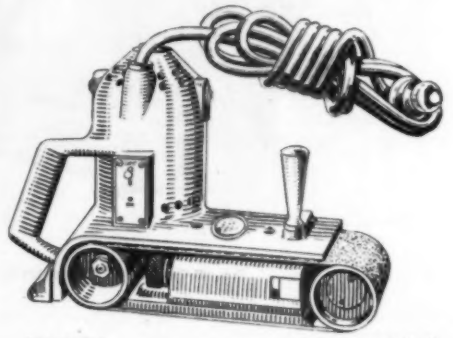


FIG. 28—PORTABLE SANDER—B.E.N. PATENTS

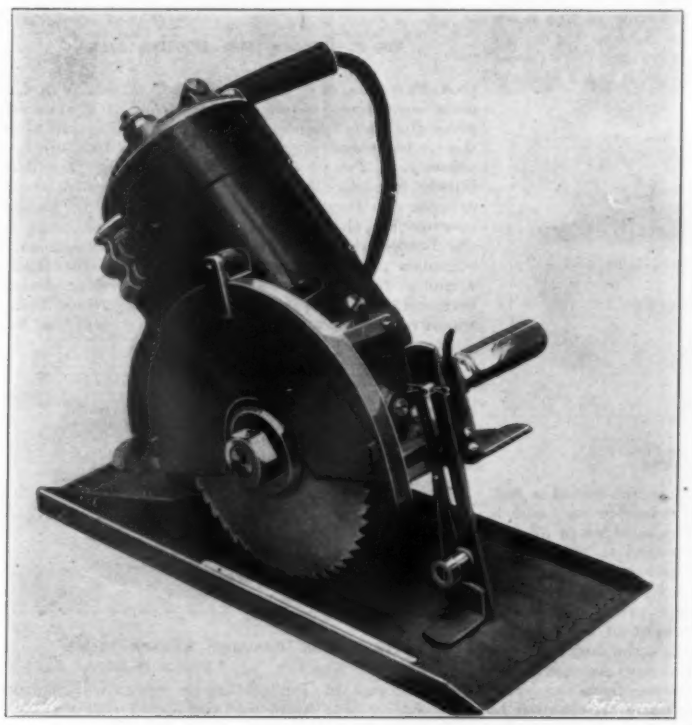


FIG. 26—PORTABLE ELECTRIC SAW—B.E.N. PATENTS

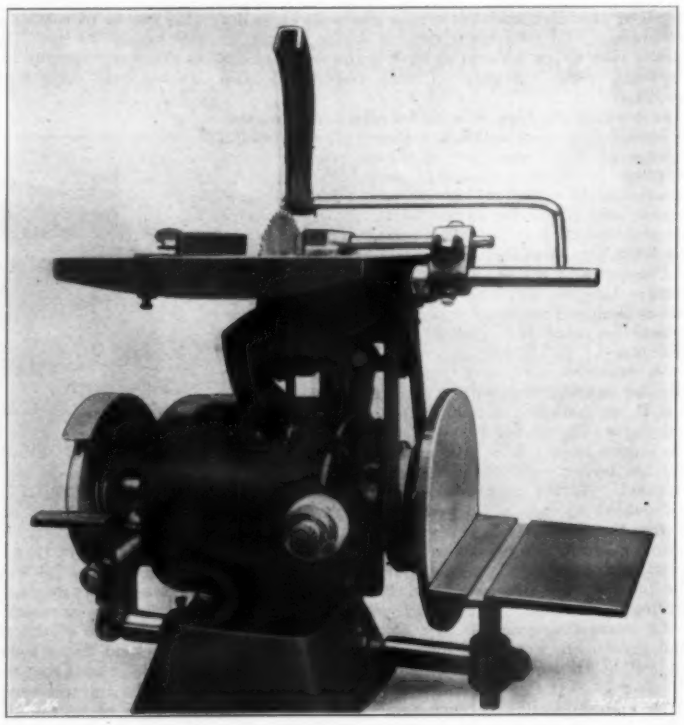


FIG. 29—UNIVERSAL SAW AND SANDER—B.E.N. PATENTS

or greater. The right-hand side of the machine is kept clear of projections in order that it may be operated right up to the face of a skirting board or similar object. The belt is 3in. in width and 24in. long. It runs at 1300ft. per minute and is kept at the proper tension automatically by means of a spring and plunger. An aluminium guard forming part of the frame protects the operator's hand from the belt. The machine can be arranged to operate not only on wood but on metal and other substances. It may be equipped with an endless felt belt for polishing and rubbing stained or painted surfaces.

THE CONSOLIDATED PNEUMATIC TOOL COMPANY, LTD

Among the numerous exhibits of electric and pneumatic drills, hammers and other portable tools on the stand of the Consolidated Pneumatic Tool Company, Ltd., of 170, Piccadilly, W. 1, there is to

FIG. 30—RIVET GUN—CONSOLIDATED PNEUMATIC

be found an example of the "Penflex" rivet gun. This appliance is designed to pass heated rivets from the minder's fire to the riveter. It permits the fire to be placed at any convenient point up to 100ft. or more away from the riveter, and renders entirely unnecessary the dangerous practice of throwing the rivets from the fire to the riveter. The rivets, it is claimed, are delivered without appreciable loss of temperature and free from scale. The complete apparatus is shown in Fig. 30, and in Fig. 31 the "gun" is shown in section. The gun consists of a pedestal or tank to the interior of which a supply of compressed air is connected. A foot-operated valve admits the air to a head piece to which a flexible tube is attached. The heated rivet is admitted into the head through an automatic trap which opens under

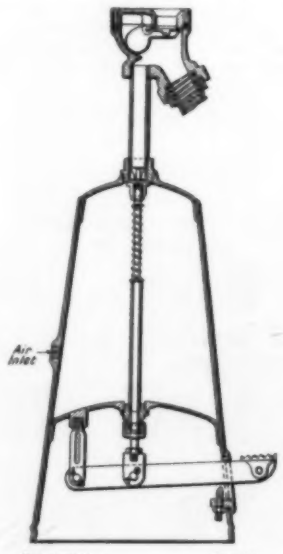


FIG. 31—SECTION THROUGH RIVET GUN

the weight of the rivet and closes when it has passed through. The depression of the foot lever thereupon results in the rivet being shot through the flexible tube at a speed of 15ft. per second. At the other end of the tube the rivet is caught in a receiver from which it is removed by the riveter. The whole apparatus weighs only 68 lb., and can be readily moved about. The tank portion is standard for all sizes of rivets, but the head is made in three sizes to suit rivets $\frac{1}{2}$in. to $\frac{5}{8}$in. diameter, $\frac{3}{4}$in. to $\frac{7}{8}$in., and 1in. to 1$\frac{1}{4}$in. When the diameter of rivet being handled is changed, the operating air pressure is adjusted by means of a set-screw, which controls the depression of the foot lever.

Another appliance shown by this company is the "Pedwyn" balancer for pneumatic and electric tools. This device is illustrated in Figs. 32 and 33. It is intended to replace the customary chain block or other means of supporting the tools, and to relieve the operator of the considerable amount of fatigue which is entailed by using heavy types of tool without

FIG. 32—PEDWYN BALANCE

a support. The balancer consists of a casing enclosing a grooved drum on to and off which the rope supporting the tool is wound. The drum is under the control of a coiled spring, the tension in which can be adjusted to suit any given weight of tool by means of a ratchet wheel and pawl on the central member to

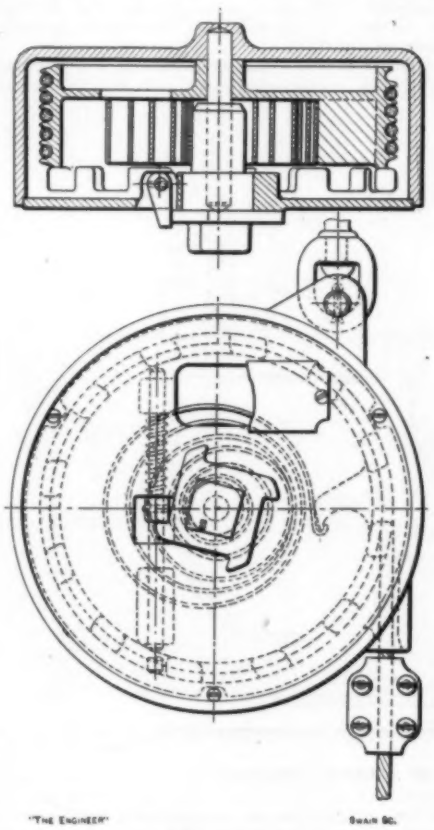


FIG. 33—PEDWYN BALANCE

which the inner end of the spring is attached. The spring is arranged to give equal tensions at all extensions of the rope, so that when once adjusted to a given weight the balance will hold that weight at any height. One edge of the rope drum is formed with tooth-like projections, with which a spring-operated plunger is held out of engagement, so long as the main spring is working properly. Should the main spring break or otherwise fail to act, the plunger falls into engagement with the teeth and stops the motion before the suspended object can fall more than 2in. With this device, it is claimed, not only is the worker relieved of fatigue, but his output is increased. In addition, it is found that it results in a decrease in the breakage of drills, reamers and taps, and as the tool when not in use is suspended in the air instead of being left on the ground, the tool itself is much less liable to be accidentally damaged. The balance is made in three sizes, which are capable of supporting 10 lb. to 50 lb., 50 lb. to 100 lb., or 100 lb. to 150 lb.

LACY-HULBERT AND CO., LTD.

The chief characteristic of the air compressors shown on the stand of Lacy-Hulbert and Co., Ltd., of Boreas Works, Beddington, near Croydon, is the fact that they have been specially designed to run at high speeds, so that they can be connected directly with normal electric motors or petrol engines. We illustrate one of the sets exhibited in Fig. 34. It is a comparatively small machine, intended for such purposes as supplying air for a paint sprayer and is mounted on a truck for portability. Its capacity is about 10 cubic feet of free air, delivered against a pressure of 100 lb. per square inch per minute. The crank case of these machines is open to the underside of the piston and is used as a pump, much in the same manner as a two-stroke oil engine. The volume of the chamber is so proportioned that when the piston is at the bottom of its stroke and has sucked in a charge of air the admission of the extra air from the crank case brings up the pressure to slightly above atmospheric. In this way the volumetric efficiency is considerably increased and the machine can be run at a high speed and still deliver a cylinder full of air at each stroke. Incidentally, it is less liable to knocking. The crank shaft is carried by a roller bearing at the crank end and by a ball bearing at the fly-wheel end, while the connecting-rod has ball bearings, so that the only sliding friction is that of the piston,

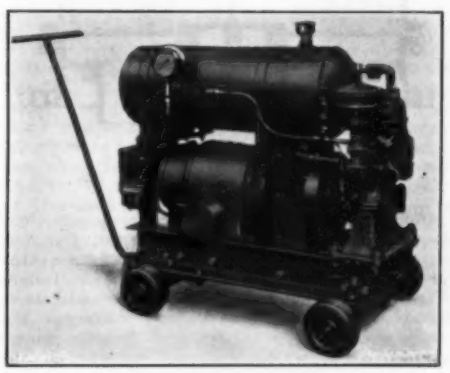


FIG. 34—10 CU. FT. COMPRESSOR—LACY-HULBERT

which is of aluminium alloy with cast iron rings. The valves are thin steel discs and their springs are light and not unduly stressed. They can all be removed for inspection without disturbing any other part. Lubrication is effected by means of a wick. The whole design is essentially one allowing of a smaller than usual machine for the same output, yet rather than cut important parts down in weight or size, the makers have given very generous dimensions to such items as the water jackets and valve pockets, and have arranged the air connections in such a manner that the cylinder cover may be removed *en bloc* without disturbing either suction or delivery air connections.

This compressor is direct coupled to a standard motor, running at about 1250 r.p.m., and a guard of perforated metal is provided to avoid the possibility of an accident occurring from an exposed coupling. The air and water container is all in one, and is carried above the machine, as shown, a suitable partition being provided between the water and compressed air. This arrangement makes the equipment very compact, small and reasonably light for its power and size. The apparatus is mounted on a strong steel frame carried on rubber-shod wheels with a swivelling front axle and a draw handle. An automatic unloading device is fitted on the inlet of the compressor which efficiently governs the pressure to within 2 lb. or 3 lb. of the desired point. The necessary motor starter is mounted in an accessible place on the plant.

Another compressor on this stand embodies many of the features just described, but is smaller and is mounted on the top of a vertical air receiver. It has an output of about 2$\frac{1}{2}$ cubic feet of free air per minute, delivered against 100 lb. per square inch, and it is capable of pumping up to 150 lb. per square inch. The compressor itself is built on to the armature of the motor and fitted with ball bearings at both ends of the connecting-rod. A water hopper is provided to cool the air cylinder and separator, which latter is useful for extracting the moisture and oil from the air before it passes to the air container.

The machine is lubricated by a suction type of

wick feed lubricator, which only feeds the oil when the machine is running, the oil being passed into the machine at the air inlet. This arrangement prevents over-lubrication and carbonisation of valves, &c.

The motor compressor is mounted on a heavy riveted steel receiver, tested to 300 lb. per square inch and fitted with a check valve, pressure gauge, safety valve, drain cock, manhole and an outlet air cock. The motor compressor is automatically controlled by a switch which can be set to stop or start the machine at the desired pressure. This arrangement provides an automatic air compressing set, which is very suitable for services such as those of garages and filling stations.

The Metropolitan-Vickers Electrical Company, Limited.

A steam operated air ejector is one of the exhibits of the Metropolitan-Vickers Electrical Company, of

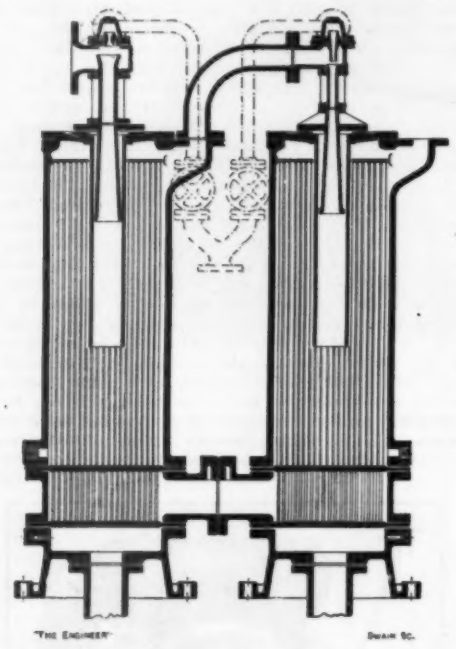


FIG. 35—AIR EJECTOR—METRO. VIC.

Trafford Park, Manchester. While in practically all cases, where high vacuum is required, the rotary air pump gives the best efficiency, the steam ejector is very frequently employed, because of the small amount of space it occupies and the entire absence of moving parts. The Metropolitan-Vickers Electrical Company's steam air ejectors are made in three principal types :—(1) A two-stage ejector without an intercooler ; (2) a two-stage ejector with a jet intercooler ; and (3) a two-stage ejector with surface coolers. In each case the principle of operation consists in projecting a steam jet at high velocity through an air chamber into a compressor pipe. The air is entrained by the steam and kinetic energy becoming transformed during the compression into potential energy, the mixture is discharged against a considerably higher pressure than that in the preceding air chamber. In order to increase the efficiency the work of compression is invariably done in two stages. In the simple ejector without an intercooler the steam consumption is relatively large, because in the second stage the steam has not only to compress the air, but also the first stage operating steam. In the type of ejector exhibited, however, intermediate and after surface coolers are fitted. The condensate from the main condenser is circulated through the tubes of the two coolers, so that the coolers perform the double function of condensing the operating steam, and at the same time increase the temperature of the feed water, thus the highest thermal efficiency for this

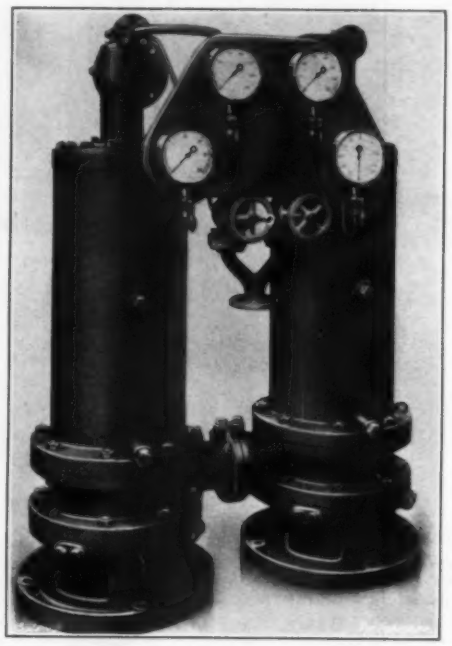


FIG. 37—AIR EJECTOR—METRO. VIC.

type of plant is obtained. The incorporation of Field tubes in the heaters is claimed entirely to eliminate all expansion troubles. The steam discharge from the ejector diffusers comes into the centre of the nest of tubes with the result that the external casing remains comparatively cool. As the diffusers are straight there is stability throughout the whole of the range of the air ejector. The illustration—Fig. 35—shows a section of the company's two-stage air ejector, with intercoolers, whilst Fig. 36 shows the method of installing it. The actual ejector is shown in Fig. 37.

Another of this company's exhibits is a horizontal split casing condensate pump—see Fig 38—capable

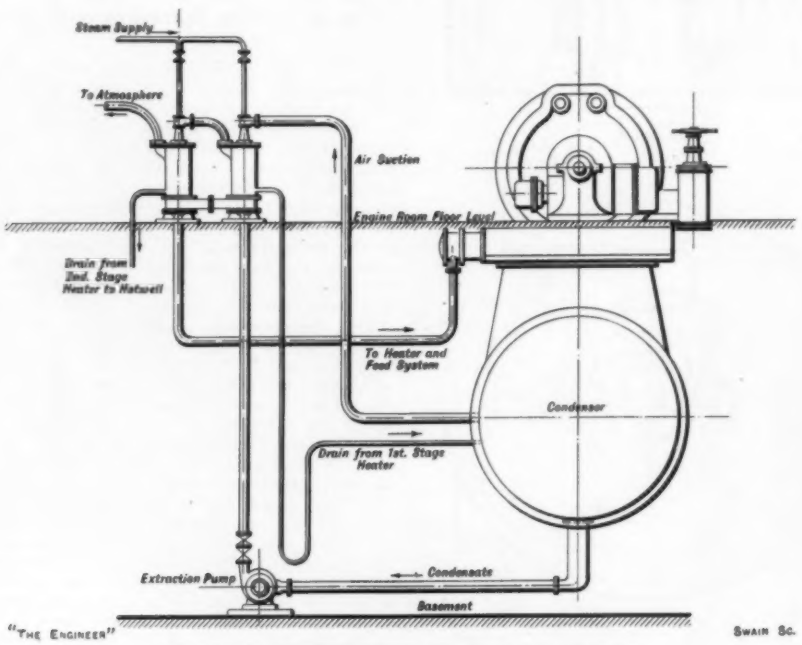


FIG. 36—AIR EJECTOR FITTED TO SURFACE CONDENSER

of dealing with various quantities of condensate up to 250 gallons per minute. The upper casing is lifted to show the internal parts, and especially the arrangement whereby the shaft on either side of the impeller in front of the glands runs in a chamber of water in connection with the pump discharge, thus preventing leakage. In addition, lantern rings are fitted so that external pressure sealing can be applied for starting purposes, &c. The pump will discharge against heads up to about 140ft., thus obviating the necessity of a separate lift pump in installations where the discharge head is high. Exceptionally large air freeing chambers are incorporated in the suction side of the pump, and in these chambers any air rises vertically in its natural direction, and is drawn away by the air pump. As the condensate is free from oxygen, it is ideal for boiler feed, and can be used with closed-feed systems. Air leakage along the shaft is prevented by large pressure chambers, placed round the shaft on

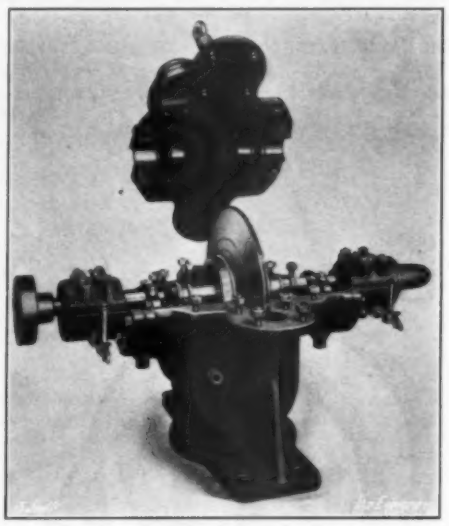


FIG. 38—CONDENSATE PUMP—METRO. VIC.

either side of the suction chamber, and connected directly with the discharge side of the pump. No water supply is required for sealing the glands. The case is split horizontally, the inlet and discharge branches being arranged in the lower half of the case, and they are not disturbed by lifting the top half of the casing.

This company is also showing a worm-driven winch, suitable for cargo or passenger boats. It is provided with a 23 horse-power 220-volt motor, designed for a speed of 400 revolutions per minute, and has sufficient power to enable the winch to lift a load of 3 tons at a speed of 100ft. per minute. The motor is a totally enclosed water-tight machine, capable of resisting breaking seas, and may consequently be mounted on the deck. It is equipped with a self-contained totally enclosed water-tight magnetic brake, capable of holding the full load suspended in the event of failure of the supply or an interruption of the circuit. The brake is equipped with a hand release lever, so that the load on the hook may be controlled in the event of the current failing. An automatic contactor equipment, so designed that it can be housed in the stand of the winch, is operated by a single lever and combines in a single set of apparatus all the necessary operating contactors and main controller arrangement. All operations are carried out by means of this single lever, which serves for hoisting and lowering. A special load relay is incorporated in the control

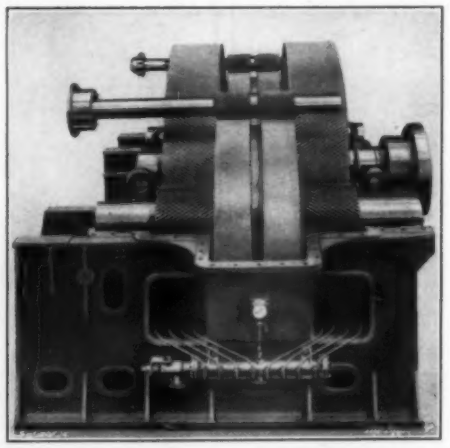


FIG. 39—TURBINE GEARING—METRO. VIC.

gear for enabling the load on the hook to be dealt with expeditiously. This relay also enables the empty hook to be returned down the hold at a speed of 350 to 400 feet per minute, thus reducing the idle portion of the load cycle. The contactors are controlled by means of interlocked switches of the mercury type, which are hermetically sealed and designed to give reliable service under sea-going conditions. The resistance for controlling the motor consists of stout "unbreakable" and non-corrodible resistance strips mounted on a mild steel framework, with a mica insulated terminal bar. This equipment is placed in a water-tight compartment in the bedplate of the winch, which has water-tight doors, thus

enabling the resistance to be inspected. An illustration of this winch is given in Fig. 40.

A high-speed pinion for a 5000 shaft horse-power main propulsion turbine is another exhibit on this stand. Single or double reduction gears are made by the firm in the rigid and floating frame types, double helical involute teeth being employed throughout. The first reduction pinions are made of specially heat-treated alloy steel, and are of hollow construction. Flexible driving shafts are passed through the pinions, and are keyed at the end remote from the gear-cutting machines. A double reduction gear is shown in Fig. 39.

The vertical motor shown in Fig. 41 is another of the Metropolitan-Vickers Electrical Company's exhibits. It is capable of developing 20 horse-power, and it has a speed range of 1200 to 1800 revolutions per minute. Mainly, these motors are employed for driving marine centrifugal pumps, and, as will be gathered from the illustration, they take up very little floor space. The machines, which are made for various outputs, are fitted with ball and roller bearings, and special thrust bearings for taking the weight of the armature and the thrust from the pump. The machine exhibited is designed for a pressure of 200 volts.

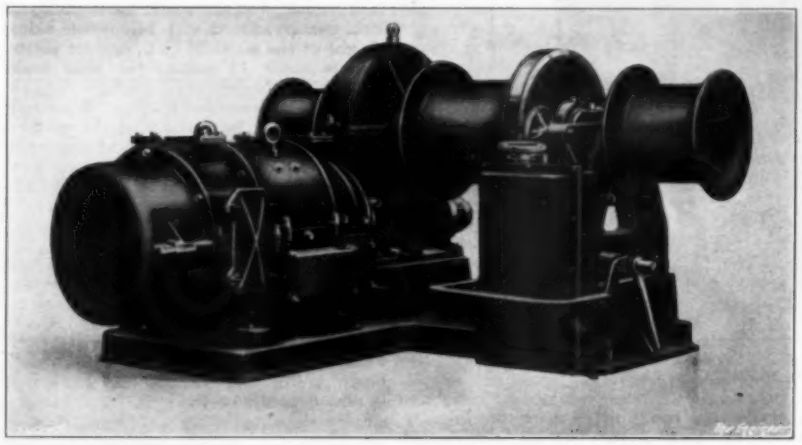


FIG. 40—ELECTRICALLY DRIVEN SHIP'S WINCH—METRO. VIC.

FIG. 41—VERTICAL MOTOR—METRO. VIC.

turbine. The second reduction pinions are cut from high-grade steel forgings, which are forged solid with their respective shafts. Both pinions are driven from their respective turbines through flexible couplings to allow them to take up their correct axial position and through flexible shafts to damp out any shocks that may be caused by slight errors in pitch or variations in propeller torque. The flexible claw type couplings allow the pinions to adjust themselves to the position required for correct meshing. Both the first and second reduction wheels have massive cast centres, which are bolted to solid flanges on their respective shafts, and are provided with forged steel rims shrunk and pinned in position. In the floating type of gears the pinion is supported in a floating frame, which allows the pinion to adjust itself to any change of alignment in the gear, and it therefore keeps the pressure of the teeth of the pinion and gear evenly distributed and uniform at all times. Even when the pinion has been forced out of line by an amount far exceeding anything that is ever likely to be caused in practice, the gear is said to have prevented anything untoward happening. More than 250 vessels have been fitted with these floating frame reduction gears, and they are said to have given entire satisfaction. To obtain the utmost accuracy in the construction of these gears, the company has developed a pinion measuring machine, which indicates errors in pitch of one ten-thousandth part of an inch. Before use, all cutters are gauged, and no gear is passed before it has undergone the most careful examination. The special gear-measuring machine is said to have led to important improvements in the

THE ELECTRIC SUBMERGED LOG COMPANY.

On the stand of the Electric Submerged Log Company, of Port of London Building, Trinity-square, E.C. 3, there are three types of electric logs with a set of distant recorder and speed indicator repeaters. The submerged log which operates the instrument is shown in Fig. 42. The rotator at the lower part of the log runs on an adjustable ball bearing, and operates a contact breaker. It makes 11¼ revolutions to every contact of the points every 400th part of a mile. Through a distributor in the main instrument box it operates the distance recorder and speed indicator. The instruments—shown in Fig. 43—are fitted in a case made of an aluminium alloy, situated in the chart room. This case contains a distance recorder registering every 400th part of a mile, the dial being calibrated up to 10,000 miles. If desired the hands can be re-set at any time. The direct reading speed indicator registers speeds from half a knot up to 36 knots; indicators for higher speeds being supplied if called for. The case also contains the distributor, controlling switches and a voltmeter. The speed indicator dial is calibrated in half knots, and is composed of two parts, a time unit and a distance unit, which work in conjunction with one another, and give the speed directly. In the event of the speed changing the instrument will indicate the change in 21 seconds. Any number of water-tight distance recorders and speed indicator repeaters can be operated from the main instrument box. The current for working the log and repeaters is obtained from an 8-volt accumulator, which is kept charged from the ship's main lighting circuit. If necessary, however, the equipment can be designed for a higher voltage. In order to avoid overtaxing the log make and break device, it only controls the electro-magnet of the main distributor, which, by means of a commutator, distributes the current at a pressure of 8 volts to the speed indicator, and its repeater, the distance recorder and its repeater, and the relay for the course recorder. Three switches are provided for putting the instruments into operation. A special feature of the submerged log is that there is no packing around the rotator shaft, and the resistance to rotation, which is practically infinitesimal, is constant at all speeds. The water-tight casing in which the impulse mechanism is enclosed is filled with oil, and brush friction at the electrical contacts is reduced to a negligible quantity. For the purposes of inspection and oiling, which should be done once a week, the log can easily be withdrawn. The instrument box with the distance recorder and separate speed indicator can be fitted in the chart room, and any number of distance recorder repeaters and speed indicator repeaters can be fitted in any desired part of the ship. The speed indicator will register the ship's speed, or the rate of tide or current from half a knot upwards when the vessel is at anchor. It is claimed to register low speeds with the same accuracy that it registers high speeds, and it will also give the correct speed when the ship is turning a sharp curve. As the log is a good distance below the surface of the water, it is clear of all floating obstructions. Pitching or rolling of the vessel does not, it is claimed, affect the accuracy of the measurements.

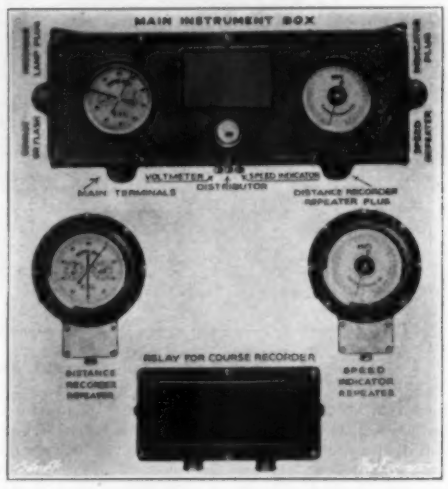


FIG. 43—DISTANT LOG INSTRUMENTS

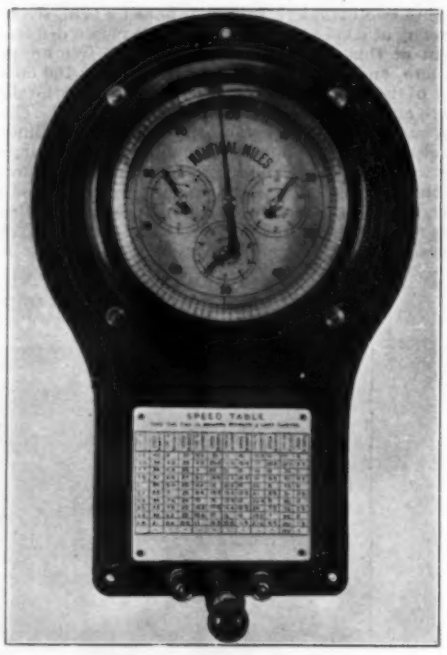


FIG. 44—RECORDING INSTRUMENT

The distance recording instrument—shown in Fig. 44 (designated type 3)—is designed for fixing

in the chart room. The dial is calibrated up to 10,000 miles, and the hands can be re-set whenever desired. Below the distance indicator dial is a speed table, which gives the speed up to 40 knots, whilst below this table there is a blue electric flash-lamp, and by noting the flashes of this lamp and by timing them with a stop watch, the speed of the vessel can be read direct from the speed table. The current for working the distance recorder is derived from a 6-volt battery, which is sufficient for a 50,000 mile run. In this case the rotator of the log, which resembles that shown in Fig. 42, makes 225 revolutions to one contact of the points in the submerged mechanism.

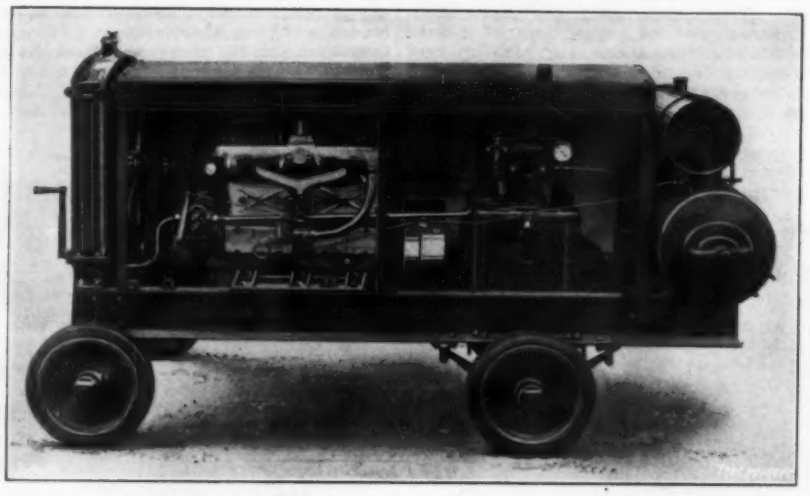


FIG. 45—100 CUBIC FEET AIR COMPRESSOR—BROOM AND WADE

BROOM AND WADE, LTD.

There are as many as five air compressing sets on the stand of Broom and Wade, Ltd., of High Wycombe, besides a selection of pneumatic tools, some sectional models, thrust blocks of the Michel type, and the compressed air haulage which we described in connection with the Engineering Exhibition at Cardiff last year.

Among the portable compressing units shown here are the two illustrated by Figs. 45 and 46. The former has a capacity of 100 cubic feet of free air per minute, and is, we understand, one of the most popular models produced by this firm. It is, as will be seen from the engraving, of the portable type, and comprises a petrol engine, air compressor, receiver, and the necessary auxiliaries all mounted on a rubber-tired truck. The air compressor is of the vertical, totally enclosed, single-acting, single-stage type, having two cylinders, each 6in. bore by 6½in. stroke, running at a speed of 600 r.p.m. The piston displacement at this speed is 128 cubic feet of free air per minute, and the guaranteed air delivery is 100 cubic feet of free air per minute. The valves are of the thin plate automatic type, and are very accessible. They are situated in a pocket on the side of the cylinder head, leaving the whole of the cylinder head available for water cooling. The lubrication to every bearing in the machine is from a positively driven oil pump, placed below the oil level on the compressor, and there are no outside lubricators requiring attention. An automatic air governor operates by lifting the suction valves from their seats, and is easily adjustable for varying pressures.

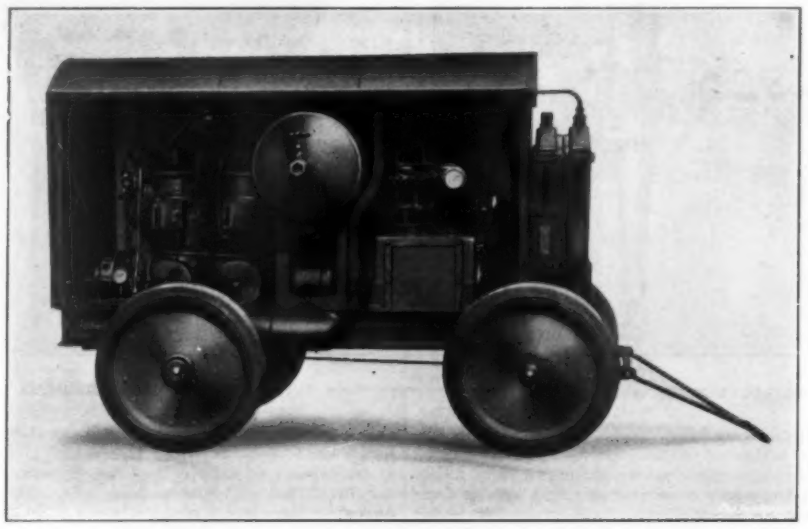


FIG. 46—CRUDE-OIL-DRIVEN COMPRESSING SET—BROOM AND WADE

The engine is of the four-cylinder four-stroke water-cooled type, having side-by-side valves and detachable cylinder heads, and is made by the Aster Engineering Company, Ltd., of Wembley. The bore is 120 mm., stroke 140 mm. The engine is equipped with a Zenith carburetter, water circulating pump and magneto, the latter being fitted with an impulse starter to facilitate starting up. The engine is coupled to the compressor through an automatic centrifugal clutch which allows it to be started up light and gradually and smoothly to pick up the load as it gathers speed. This clutch is simple and positive, and also acts as a flexible coupling to accommodate any distortion which may take place in the chassis due to its standing on an uneven surface. The radiator is of the rigid type with pressed steel headers, and is fitted with a large diameter fan running on ball bearings, driven by a Whittle belt. The radiator is amply large enough to cool both the compressor and the engine during continuous running without the water boiling. The chassis is made of 8in. by 3in. channels, is fitted with cast iron wheels and solid rubber tires. Both the front and rear axles are mounted on springs. The front axle is swivelling, in both directions, and a draw bar is fitted. Powerful brakes are fitted to the rear wheels and are operated by a hand lever on the side of the machine. The air receiver is 18in. diameter by 48in. long, and is of riveted construction. It is fitted with an inspection door, pressure gauge, drain cock, and four outlet cocks, ¾in. gas. The receiver is hydraulically tested to 190 lb. per square inch. The petrol tank, which is mounted above the air receiver, is made of 16-gauge material galvanised. The water piping throughout is of copper, and the whole set is enclosed by a sheet steel canopy, fitted with removable sides. The net weight of the set is 35 cwt., and its petrol comsumption is about 1¾ gallons per hour under ordinary working conditions.

The set represented by Fig. 46 is noteworthy on account of the fact that it is driven by a crude oil engine, which is one of Messrs. Petters standard two-cylinder units. The compressor itself has two cylinders, and has an actual output of 120 cubic feet of free air per minute delivered against a pressure of 100 lb. per square inch. This machine runs at a speed of 525 revolutions per minute.

The other compressors on this stand include a four-cylinder 10in. by 12in. vertical totally enclosed set of standard "Broomwade" design, with an actual output 600 cubic feet at pressures up to 120 lb. per square inch. This machine, in common with all "Broomwade" compressors, has forced lubrication to all the bearings from a positively driven oil pump. There is also a two-cylinder 8½in. by 10in. compressor of similar design, having an actual output 200 cubic feet of free air per minute at pressures up to 100 lb. per square inch, arranged to be driven by steam. The steam cylinder is mounted in tandem with the air cylinders. Finally, there is a two-cylinder 7in. by 8in. compressor of similar design but fitted with the "Typhoon" type of gearing with one half of gear case removed.

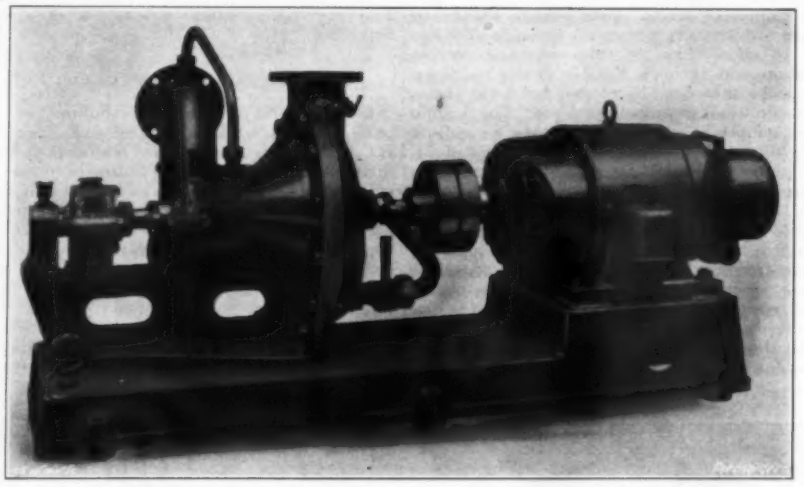


FIG. 47—HIGH-SPEED CONICAL PUMP—MUMFORD

A. G. MUMFORD, LTD.

A wide range of pumping machinery for both marine and land use is to be seen on the stand of A. G. Mumford, Ltd., of Colchester. From the sixteen or more pumps exhibited here, which include feed pumps, air pumps, oil fuel transfer pumps, and bilge pumps, we have chosen three typical examples for description. One of the principal exhibits is a vertical electrically driven "Duplex" pump for oil fuel transfer duty. The pump has a cast iron body and is fitted with steel valves. It has 7in. diameter barrels with a stroke of 8in., and is driven by an electric motor, which is mounted on a cast iron stand, and attached to the combination bed-plate. On this pump double reduction gear is fitted, the first reduction taking place through spur gearing. A "Fabroil" pinion on the motor shaft meshes with a cast iron spur wheel on the back shaft, and a further decrease in speed is effected by double helical gearing.

Another, similar but smaller, type of pump is the electrically driven Duplex pump, with a silent worm drive, which we show in Fig. 48. It was specially designed for bilge pumping duty on a yacht, for which work absolutely silent running was essential. As shown by our engraving the two pump barrels, which have each a bore of 3½in. with a stroke of 3in., are driven through a worm reduction gear which is mounted between the cranks. The driving motor is placed at the back of the pump, a neat arrangement thereby being obtained. In the pump shown, a by-pass connection is fitted between the suction and the discharge chambers.

In our issue of July 2nd, 1926, we described and illustrated the "Niagara" conical rotary pump, which is built under Mumford's and Tait's patent. A small size of pump of this new type is displayed at Olympia, and we illustrate it in Fig. 47. The main casing is

conical in form, with the inlet passage arranged at one end, and the volute which leads to the discharge passage at the other. A ribbed bed-plate is provided, which is cast in one piece with the pump body, and is extended to carry a thrust bearing of the solid marine type. The impeller is a cone-shaped worm furnished with threads on its outer periphery. It is mounted on a spindle which also carries the thrust collars. By adjusting the thrust bearing any degree of clearance between the worm and the pump casing can be obtained. The design of the thrust block is such that adjustment can quite well be made while the pump is in operation. With the inlet branch as arranged the pump is self-priming. In the model exhibited, the pump and its driving motor are

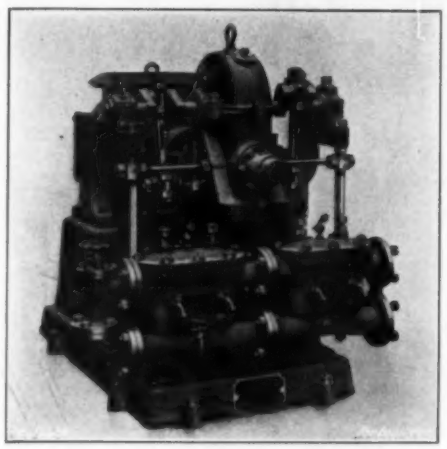


FIG. 48—BILGE PUMP—MUMFORD

mounted on a common bed-plate, and the designed speed is 3000 r.p.m., which gives a high output for a pump of relatively small size. Such units have, we understand, successfully been used for fuel, lubricating oil and brine pumping. Other exhibits on this stand include a full-sized model of a boiler steam drum, with one of Mumford's patented automatic feed water regulators mounted in position, and complete with all its connections. The working of the feed regulator is demonstrated by a full-sized sectional model.

REAVELL AND CO., LTD.

A wide range of air compressing machinery, designed for varied industrial and marine uses, is to be seen on the stand of Reavell and Co., Ltd., of Ipswich. From the fourteen or more different types of air compressors which are shown we have chosen three typical machines for description and illustration. An interesting compressor is the re-designed high-speed Quadruplex compressor, with roller bearings, which is exhibited for the first time. In drawing, Fig. 49, we reproduce sections through the compressor, which is a 6in. by 4in. unit, designed to run at 800 r.p.m. and to deliver air at 120 lb. per square inch pressure.

Instead of the overhung crank pin in the original compressor, the shaft of which was supported by substantial ring-oiled bronze bearings, the new machine has a dip crank with a bearing at each side. The dip crank, it will be seen, is in two pieces; one portion is formed by the shaft with one crank cheek and the crank pin, while the other crank cheek and the extension shaft is secured to the crank pin by a tapered cone and nut, so as to enable the convenient assembly of the connecting-rods.

The four pistons are of the usual pattern and embody, generally, the Corliss principle, for the admission of the suction air by means of suitable ports provided in the gudgeon pin and in the piston. The new connecting-rod entirely differs from previous practice, for each connecting-rod has itself a crank end made in the form of a circular ring, like one eye of a pair of spectacles. This ring carries the outer race of a roller bearing, and on the crank pin is secured a steel sleeve, on to which the inner races of the four roller bearings for the four connecting-rods are mounted. The two ends of the shaft also run in roller bearings, and lubrication is effected under pressure from the mechanical lubricator fixed at the end of the machine. The oil enters through the crank and web to a hole in the centre of the crank pin, whence it passes outwards through holes to the four roller bearings of the connecting-rods. The new compressor we have described and illustrated has, we learn, enabled rotational speeds to be practically doubled. Smoothness of running is ensured by accurately balancing the whole of the moving parts by balance weights, which are made integral with the crank cheeks. The general compactness of the new design may be remarked upon.

As in the earlier type of quadruple compressors, a circular casing containing the cylinder is provided with suitably cored passages for the circulating water and the delivered air, but in order to provide for the four connecting-rods—which are only slightly offset from each other—the cylinders are staggered in relation to each other, and at the same time they are cast integral with the casing. The whole casting, we may say, forms an excellent example of modern foundry practice.

The speeds at which these compressors now run allow high-speed motors to be employed, and no gearing of any kind is required.

Another noteworthy exhibit on this stand is a vertical tandem steam-driven three-stage compressor of the single crank type—see Fig. 50—which is supplied for use as an auxiliary compressor on oil-engined ships. The capacity of the machine is 58 cubic feet per minute at 500 r.p.m., when working against a pressure of 1000 lb. per square inch. The air cylinders are single-acting, the second stage being formed by the annulus below the low-pressure piston which has the high-pressure piston superimposed on it. In the first and second stages valves of the plate type are fitted, and tubular intercoolers are employed. The third-stage cylinder is fitted with specially light, high-pressure, suction and delivery

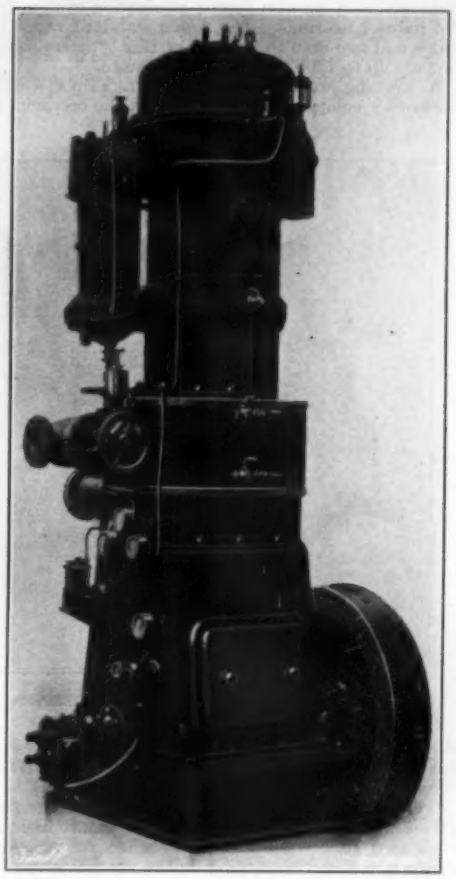


FIG. 50—STEAM-DRIVEN AIR COMPRESSOR—REAVELL

valves of the mushroom and thimble type. An after-cooling coil is also provided, which is specially stayed to its casing. Both the valves and after-cooling coil are completely jacketed, so that the temperature at which they work is kept low, and so prevents the carbonisation of the lubricating oil. Nevertheless, by removing the top cover and lowering the water level slightly, the coils and valves can be quickly and easily examined if required.

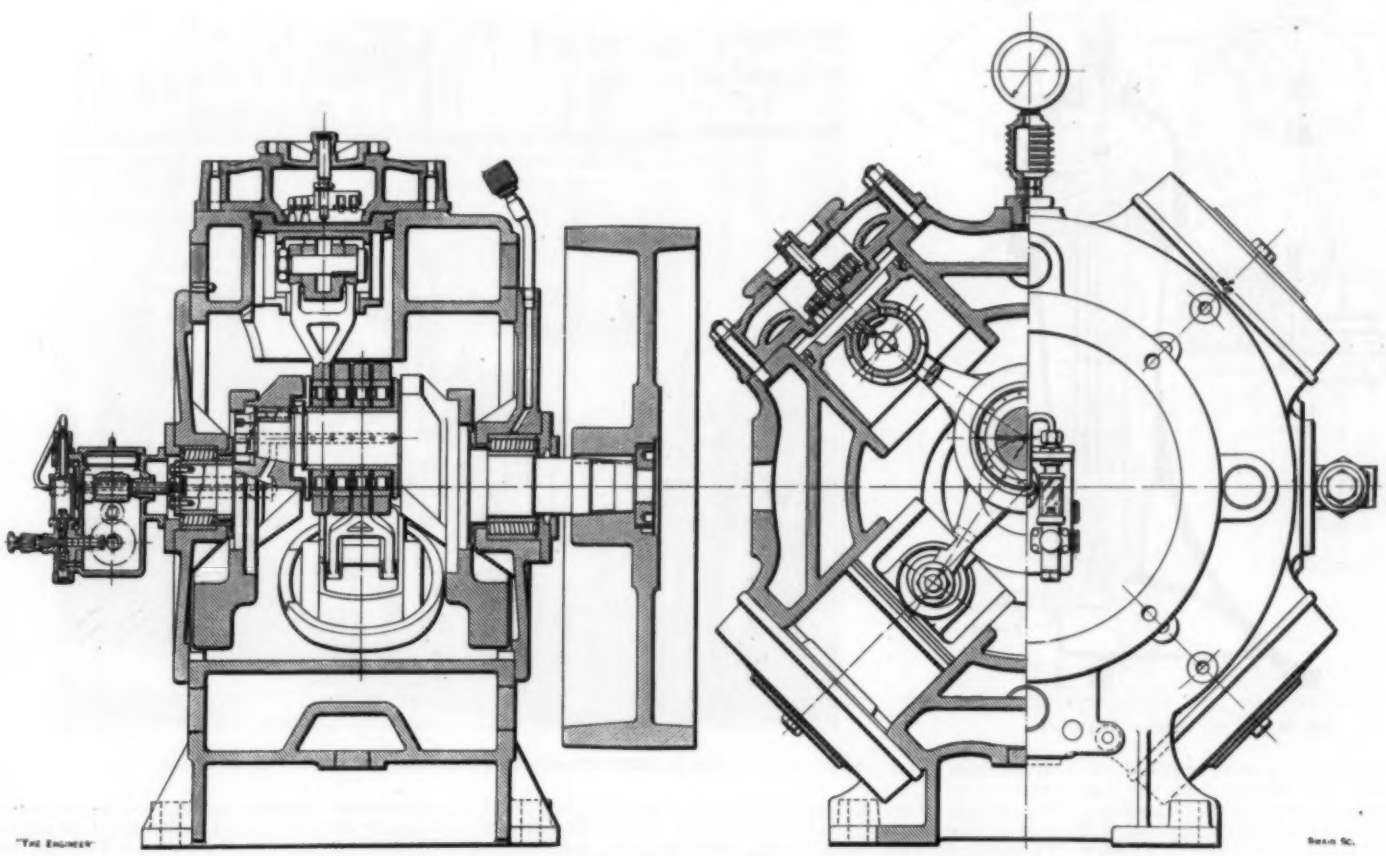


FIG. 49—SECTIONS THROUGH HIGH-SPEED QUADRUPLEX AIR COMPRESSOR—REAVELL

The steam cylinder is of the double-acting type, with a piston valve, which is driven from an excentric on the crank shaft. For motor-driven machines the air compressing cylinders are similar in type, and they are mounted directly on the crank case. A totally enclosed type of crank case is then used, which is complete with its own forced lubrication system for the journal bearings. The firm's standard range of single and two-crank machines of this type embraces outputs up to 1200 cubic feet per minute.

A working exhibit is the 35-cwt. ship's winch, worked by compressed air, which, on the occasion of the visit of the Institute of Naval Architects to Ipswich, we examined at the firm's works. It is shown in Fig. 51.

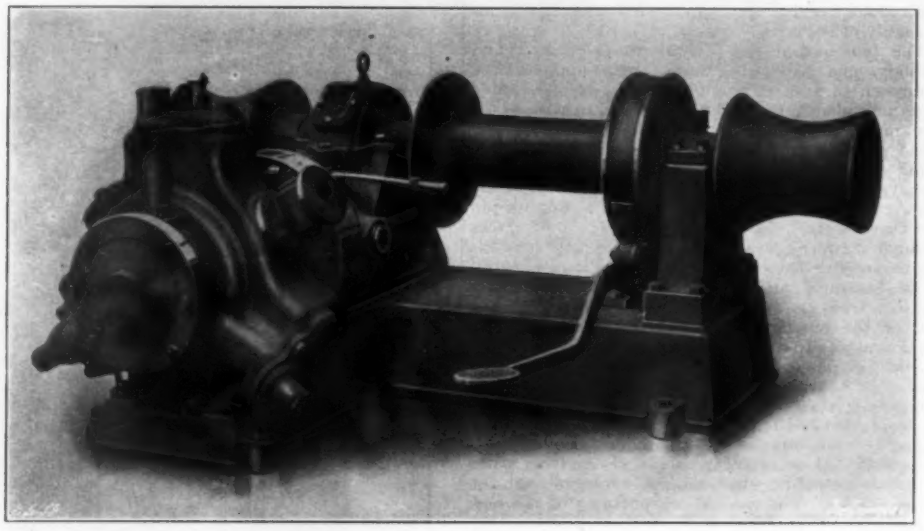


FIG. 51—COMPRESSED AIR SHIP'S WINCH—REAVELL

The winch is fitted with an air engine of the low-pressure non-expansion type, so as to ensure freedom from any trouble due to freezing when the vessel on which it is fitted is working during the winter. It is of the totally enclosed automatically lubricated type, with three cylinders driving on to a common crank pin. The air supply passes through a common port cast in the casing connected to each of the cylinders, and it exhausts into the crank case of the engine through Corliss ports in the piston and gudgeons. An air supply main is the only pipe required for this system, though a short length of pipe may be fitted to allow the exhaust from the engine to blow to atmosphere in a convenient position. The engine is capable of immediately starting under load in any position, and it is fitted with a control cock operated by a simple lever, by means of which the rate of hoisting can be regulated. Loads can be lowered by choking the exhaust without the necessity of using the brake, and it is possible by the operation of this cock to arrest the downward load instantly and to hold it in any position.

The drive of the air engine to the winch is by worm and worm wheel completely enclosed and running in oil, the thrust being taken up by a ball thrust bearing. The engine is connected to the worm shaft through a reversing dog clutch, the lever of which is arranged in a convenient position adjacent to the control cock. By these means the winch can be reversed for lowering a light hook or the engine can be put in neutral in order to obtain a free barrel. An efficient foot-operated brake of the friction band type is a precaution, although, as already mentioned, complete control is given by the operating cock.

Whipping drums are fitted at both ends of the barrel shaft, which is carried in adjustable gun-metal bearings. The winch exhibited is designed to lift 35 cwt. at a speed of 60ft. per minute, and it can deal with lighter loads at higher speeds. It is also capable of dealing with heavier loads at proportionately reduced speeds or by the intervention of a double purchase.

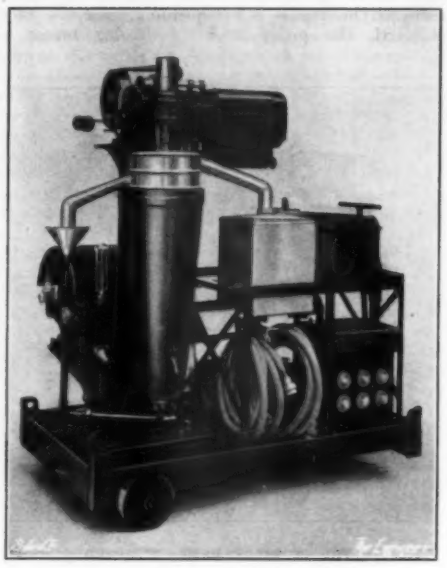


FIG. 52—OIL SEPARATOR—SHARPLES

SUPER-CENTRIFUGAL ENGINEERS, LTD.

The purification of fuel and lubricating oil is a matter which is now receiving increased and deserved attention on motor vessels, on steamships and in power stations, and such purification has now become an integral part of many industrial processes. Apparatus designed for this work will be found on the stand of Super-Centrifugal Engineers, Ltd., of Aldwych House, London, W.C. 2, who are showing various types of Sharples centrifugal oil purifiers. We illustrate in Figs. 52 and 54 a totally enclosed fuel and lubricating oil purifier. Some such apparatus now generally forms a part of practically every modern installation of marine propelling machinery. The diagram of the Sharples machine, which we reproduce in Fig. 52, is largely self-explanatory. The Sharples Super-Centrifuge, as it is termed, consists essentially of a long hollow cylinder or bowl, which is revolved at a speed of 15,000 to 17,000 r.p.m. As the engraving shows, the bowl—which has a depth of approximately 30in. and a diameter of 4½in.—is suspended by means of a flexible steel spindle from a simple ball bearing. A boss which extends downward from the bottom of the bowl enters a guide bushing, flexibly held in position by a spring. With such a mounting the rotating bowl can obviously take up its own position, and no stress of any kind is imparted to the housings. It is driven by 2½ B.H.P. motor, made by the British Thomson-Houston Company, Ltd., of Rugby, which runs at a designed speed of 3500 r.p.m. In the type of machine we illustrate, the driving belt is of woven cotton and the desired degree of tightness is maintained by a weighted idler pulley. A light hand brake is fitted near the bottom of the bowl casing.

The oil enters the bowl through a passage in the bottom which coincides with the aperture of the feed tube. A three-vaned wing-piece is fixed within the bowl so that the liquid to be treated is always maintained at the same speed as the rotating shell. The oil passes up the walls of the bowl with a smooth streamline flow until the discharge orifices at the top covers

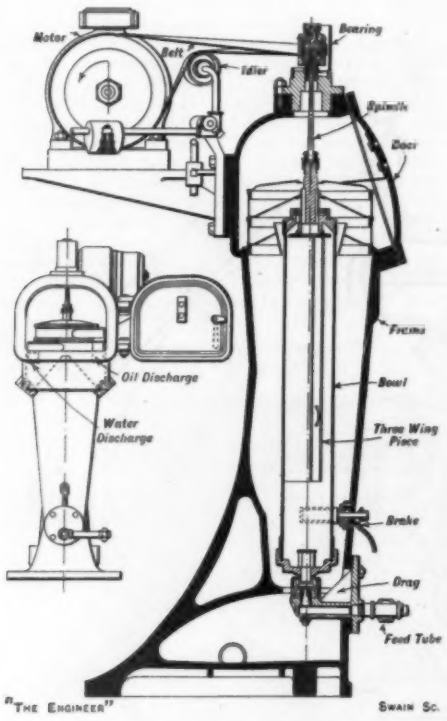


FIG. 53—OIL SEPARATOR—SHARPLES

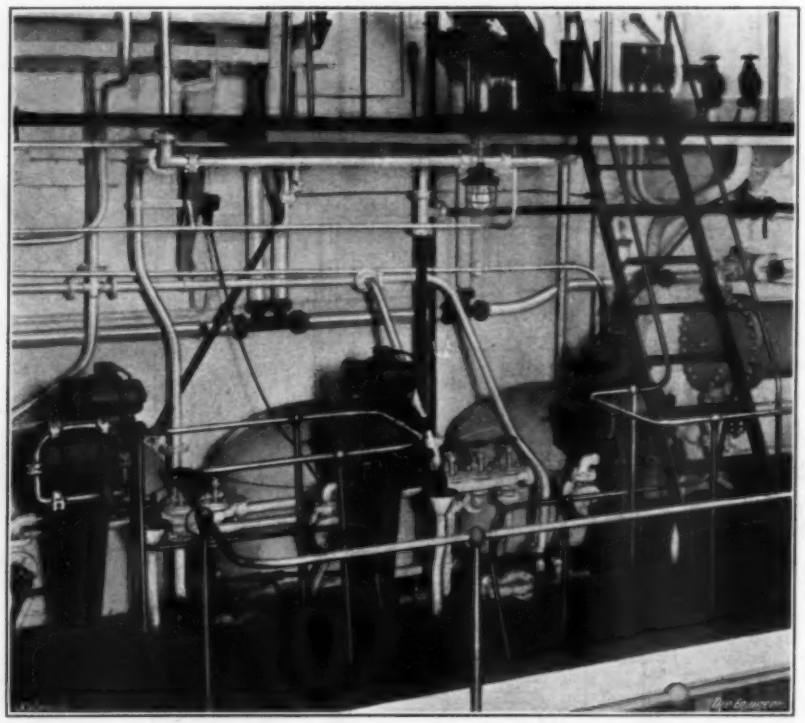


FIG. 54—CENTRIFUGAL OIL SEPARATORS ON SHIPBOARD—SHARPLES

are reached. Separate outlet covers are arranged for oil and water which lead to the discharge pipes. In the design of machine illustrated in Figs. 52 and 53 the whole of the top part of the purifier is enclosed by a large D-shaped door, which gives easy access to the covers and the bowl, and is stated entirely to do away with oil fumes. Any solid matter remains in the bowl, and as this component consists only of three simple parts, while it does not weigh more than 37 lb., it can be quickly lifted out and cleaned. The whole

operation of shutting down the centrifugal, taking out the bowl, cleaning and replacing it, and again bringing the machine up to speed, does not take, we are informed, more than ten minutes.

An important advantage of the Sharples oil purifier is the very small gyroscopic force which is set up by the narrow and lengthy bowl employed. The absence of large gyroscopic forces enables the machine to work smoothly and continuously, we understand, in any part of the ship, even in a heavy seaway. We show in Fig. 54 an installation of three Sharples enclosed purifiers on one of the intermediate gratings of the motor vessel Port Freemantle.

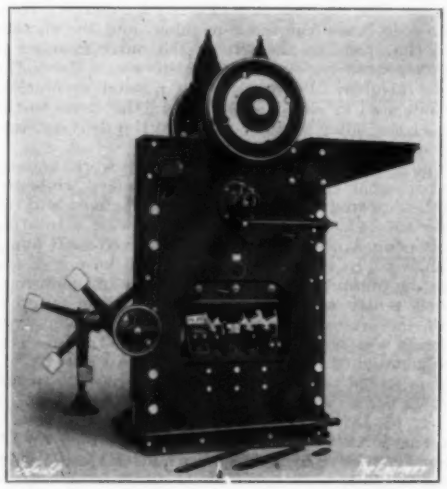


FIG. 55—200-TON SPRING PRESS—PELS

The installation shown in Fig. 53 comprises a portable Sharples oil purifying set specially designed for dealing with turbine lubricating oils and transformer oils in power stations and industrial works. It consists of a No. 6 Sharples Centrifuge, which is belt driven by a 3½ B.H.P. electric motor, mounted on a bracket at the back of the frame. Fast and loose pulleys are provided, and there is a speed transformer gear with a belt-tightening arrangement. The dual suction and delivery pumps are driven from the same motor and a starting rheostat is provided. In order to heat the oil, a series of electric heating elements of 18 kW total capacity with six 3 kW stages, are employed, each of which is controlled by its own switch. The apparatus is complete with a receiving tank for the purified oil, and this tank is furnished with an inspection lid. There is also a bowl rest and vice, and a coil of flexible connecting piping. The Centrifuge and the auxiliary apparatus are all mounted on a substantial steel truck, which is furnished with three wheels. A draw-bar handle is fitted, as are also corner lifting eyes for crane use.

HENRY PELS.

On the stand of Henry Pels, of 32–38, Osnaburgh-street, London, N.W. 1, a selection of punching and shearing machines and presses are shown, all of which are characterised, as is usual with this firm, by the fact that the frames, instead of being of cast iron, are built up of high-tensile steel plates.

One of the machines exhibited is the 200-ton laminated spring press, illustrated in Fig. 55. This machine, we are informed, is of an entirely new design, and has recently been supplied to the London, Midland and Scottish and other home and overseas locomotive and carriage and wagon works. The machine is designed for cold finishing the leaves of laminated springs, and has reached an output of 25 tons per week on 4in. by ⅜in. material for 55 tons tensile strength. It is equipped with five sets of tools designed for the following operations, all of which are done on the material in the cold state:—(*a*) Cutting to length, (*b*) centre holing, (*c*) spearing the ends to the required shape, (*d*) nibbing, and (*e*) slotting. Each set of tools is provided with its own gauge. The machine is driven by a motor of about 7½ H.P. The fly-wheel runs at 200 r.p.m., and the machine is capable of making twenty-two strokes per minute. A claw clutch of the three-point type enables the motion to be engaged or disengaged at any one of three points during each stroke. The clutch is operated by means of a treadle extending across the front of the machine. The clutch may be locked from this treadle for continuous working, or it may be thrown out of gear, in which condition the machine-cut single gearing. As in the previous instance, there is a treadle-operated claw clutch in the drive, which enables the machine to be operated continuously at its full speed of thirty strokes per minute or automatically disengaged after each stroke. The ram is counterbalanced by a weight and executes a movement which may be adjusted from ¾in. to 4in. The position of the ram stroke may be varied over a range of 4¾in. The ram has a surface of 24in. by 14in. and the table a surface of 32in. by 22in. At the ram automatically returns to the top of its stroke. The shearing slide is of cast steel, and is balanced by means of two heavy springs. It works in long adjustable box guides and provides an area measuring 32in. by 11in. for the attachment of the tools. The table has a surface of 34in. by 13in., and between it and the ram there is a maximum clearance of 16in. If desired, the set of five standard tools can readily be made to interchange with a shearing attachment, enabling mild steel plates up to 24in. by ¾in. to be cut.

Another new design of machine on the same stand is the 200-ton press illustrated in Fig. 56. As exhibited, this machine is equipped with punching tools for the manufacture of pipe flanges. The machine is, however, capable of many other applications, such as punching out draw bar hooks and punching and shearing sole bars, fish-plates, and so forth. In our engraving a diagram is given showing the tool equipment provided for trimming the fins off buffer forgings. The frame is composed of steel plates stiffened and held together by cast steel distance pieces. The machine may be driven electrically or by belt, the transmission being taken through heavy

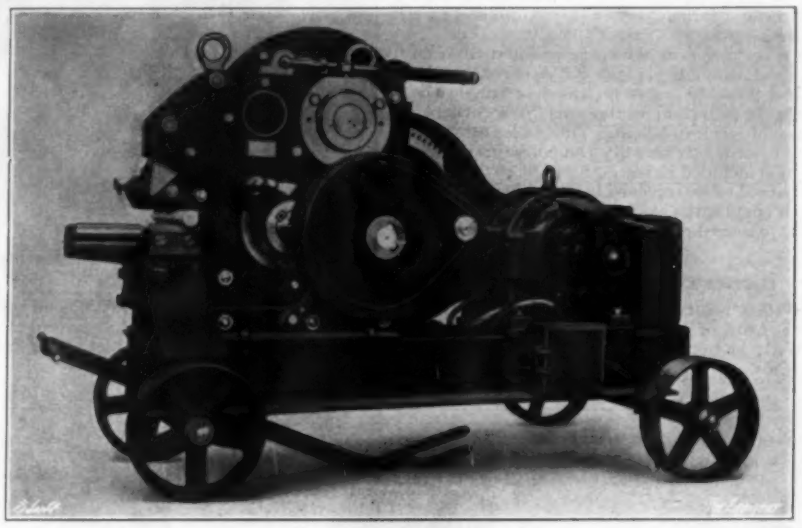


FIG. 57—BAR SHEARS FOR REINFORCING RODS—PELS

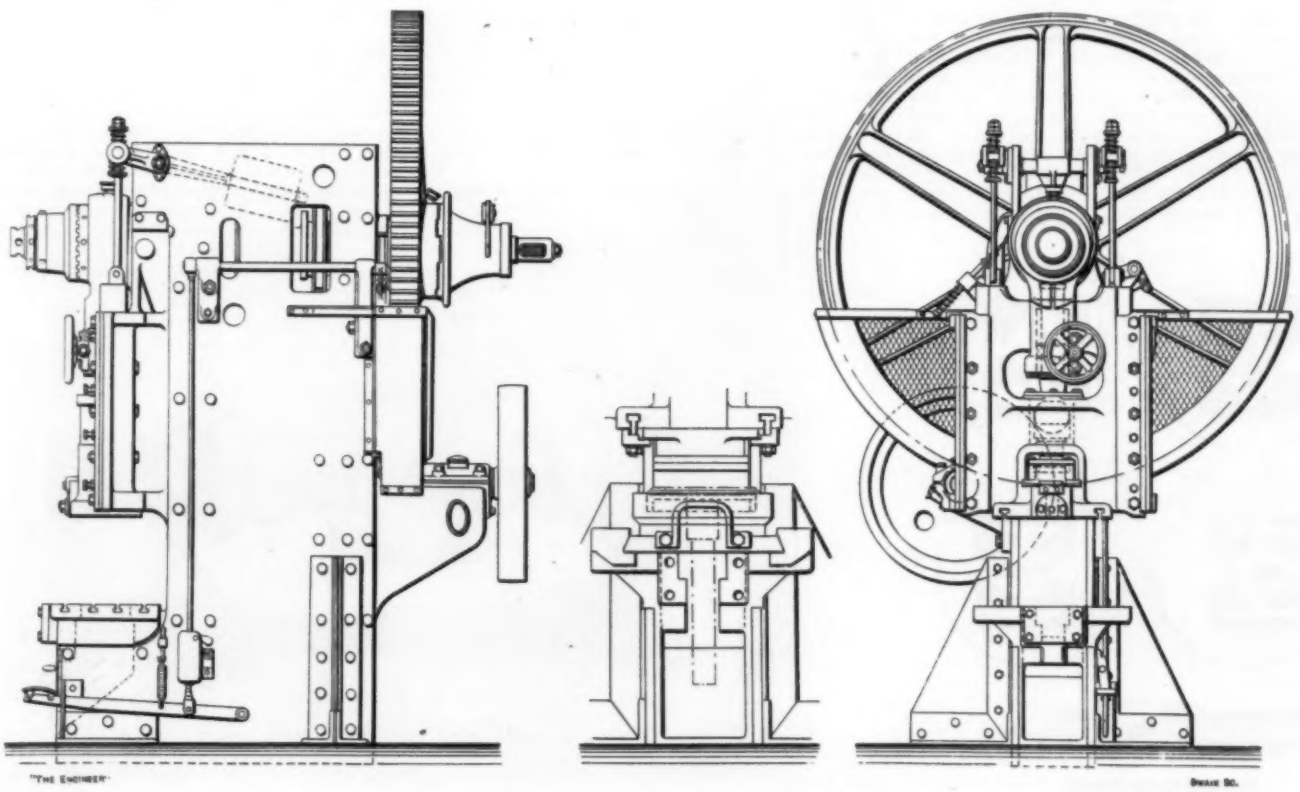


FIG. 56—200-TON STEEL-FRAMED PUNCHING PRESS—PELS

centre of the table there is an opening measuring about 12in. by 10in., through which the pieces punched out may fall and be ejected on to the floor. From the centre of the ram to the back of the gap there is a clear depth of 12in. The machine absorbs about 10 horse-power, and has a fly-wheel speed of 425 r.p.m.

A third example of Mr. Pels' exhibits is the portable open-ended shearing machine for reinforcing rods, illustrated in Fig. 57. This machine is designed to deal with mild steel in rounds up to 1½in., squares up to 1¼in., or flats up to 4in. by ⅝in. or 2in. by 1in. It is driven by an electric motor of about 3½ H.P., running at 1500 r.p.m., which transmits power through double reduction gearing to the upper knife and to a fly-wheel running at 500 r.p.m. The upper knife is carried on a rocking arm, which is operated from an excentric shaft through a plunger. A crank handle fitted with a locating pin is provided to enable the upper knife to be raised or lowered in accordance with the size of stock to be cut. The blades are 4¾in. in length. In order to simplify the construction, no stop motion is included in the design, but to facilitate operations a feed roller is placed in front of the bottom knife, which enables the operator to feed the material to the right extent before he inserts it for shearing purposes.

British Quadruplex, Ltd.

The valveless rotary pump exhibited by British Quadruplex, Ltd., of Parliament Mansions, Victoria-street, S.W. 1, has only three moving parts, and is

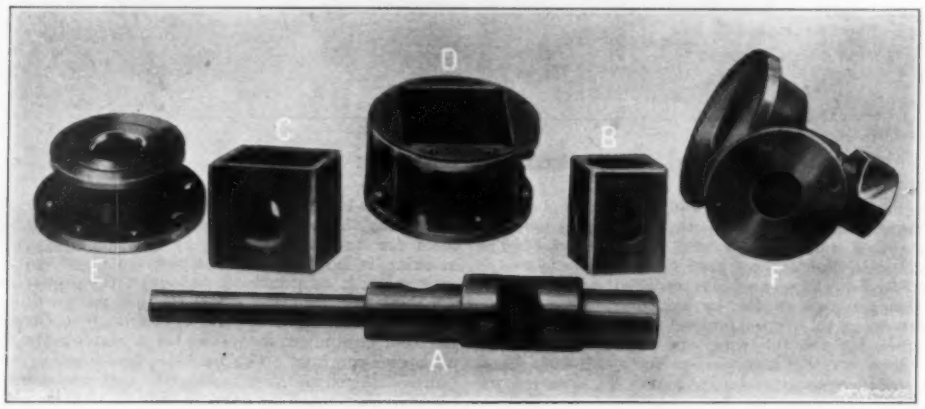


FIG. 58—COMPONENT PARTS OF QUADRUPLEX PUMP

claimed to require no priming, to be capable of producing a suction lift up to 28ft., to give an even and continuous flow, and to be suitable for dealing with water, oil, acids, gases, air and other fluids. It is further claimed to have a high efficiency and low weight, to occupy very little space, to work satisfactorily at any angle in any plane, to require no lubrication, and to pump the fluid without unduly stirring it.

The component parts of the Quadruplex pump are shown in Fig. 58. Sectional drawings explaining

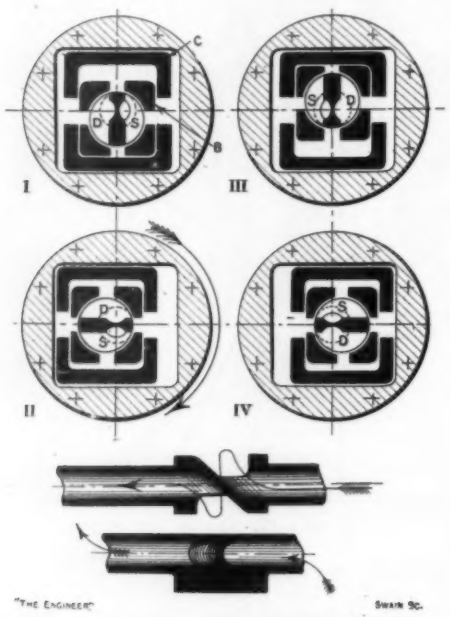


FIG. 59—SECTIONS THROUGH QUADRUPLEX PUMP

the action are reproduced in Fig. 59. In Fig. 58 A is the central shaft. This shaft is hollow, and is formed with an excentric portion at one point of its length. Over this excentric portion there fits the inner member B, a square sectioned block with a port in each face. This member fits within an outer member C, which is a square sleeve with a port in two of its faces. These parts are assembled within the body D, a short cylinder with a square bore. The front end plate E of the body carries a gland through

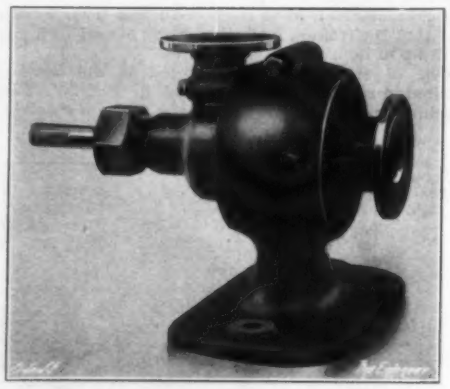


FIG. 60—QUADRUPLEX PUMP WITH ROTATING SHAFT

which the shaft A passes. The rear end plate F also carries a gland, and in addition is provided with a branch at right angles for the inlet of the fluid.

The central shaft, as indicated in Fig. 59, is formed with a bore which is divided into two portions by a sloping wall of metal at the point of its length at which the excentric portion is formed. On opposite sides of the sloping wall ports are formed in the excentric. The fluid flowing along the central shaft passes out through one of these ports—the suction port—and then in through the other—the delivery port—into the second portion of the central shaft. In the cross section in Fig. 59, S denotes the suction and D the delivery port of the central shaft. As the shaft rotates the inner member B rises and falls relatively to and within the outer member C. The outer member in turn moves from side to side relatively to and within the bore of the casing. In position I. the space to the right of the outer member and the space below the inner member are increasing in volume, and for a quarter of a revolution or so they are in communication with the suction S. They therefore become charged with fluid. During the same quarter revolution the space to the left of the outer member and the space above the inner member are decreasing in volume and are in communication with the delivery D. The fluid in them will therefore be expelled. It will be noted that during this quarter revolution the two spaces reach their maximum delivery epochs at complementary times, with the result that the delivery is maintained substantially constant. A similar remark applies to the suction taking place simultaneously on the opposite sides of the members. In position II. delivery is being momentarily effected entirely from the space above the inner member and suction entirely into the space below that member. With the commencement of the second quarter revolution the space to the right of the outer member opens to the delivery passage and the space to the left opens to the suction. The four spaces again co-act to give substantially constant delivery and suction, as indicated in the third section showing the configuration of the parts at the end of the second quarter revolution. With the beginning of the third quarter revolution the delivery from the space to the right of the outer member is reinforced by delivery from the space below the inner member, and the suction into the space to the left of the outer member is supplemented by suction into the space above the inner member. During the last quarter revolution, as indicated in sections IV. and I., the space to the left of the outer member takes up the delivery, and the space to the right the suction.

The design of the pump is such that it works equally well whether the body is held stationary while the shaft is rotated or whether the shaft is fixed and the body rotated. In Fig. 60 a pump with a rotating shaft is illustrated, and in Fig. 61 a fixed shaft pump is shown. In the second case, it will be noted, the rotating pump body is made externally in the form of a belt pulley and can be so driven. The pump is made in various forms and sizes. A small pulley type is made with a pulley diameter of only 3·15in. This size is designed to be run at from 500 to 1500 r.p.m., and is stated to be capable of delivering 220 to 660 gallons per hour respectively against a total head of 114ft. to 132ft. At the other end of the scale a rotating shaft pump is made to run at 1500 r.p.m., and to deliver 16,000 gallons per hour against a total head of 196ft.

Sheepbridge Stokes Centrifugal Castings Company, Ltd.

On the stand of the Sheepbridge Stokes Centrifugal Castings Company, Ltd., of Sheepbridge Works, near Chesterfield, there is a variety of castings, mainly employed for the production of piston rings, cylinder liners, sleeve valves, gear blanks, &c., in grey iron and non-ferrous metals. The castings are manufactured from specially refined metal in cast iron dies, which rotate at high speeds on a horizontal axis. This method of manufacture, which utilises the centrifugal action of the spinning dies, has a separating action on the molten metal, whereby any light inclusions in the metal, such as dirt or gas, are segregated to the inside surface of the casting, while the metal is still molten, and then removed during the casting process by introducing a slight excess of metal, which spills out at the end of the mould. In this way the castings are freed from blow-holes and other defects often found in sand castings. The metal walls of the dies, being highly conductive, effect a rapid and uniform cooling of the metal, whilst it is still rotating at a high speed, and so produces an exceptionally close-grained structure of high wearing qualities. Fractures are shown on the stand of this company illustrating this structure, and also highly magnified micro-photographs which reveal the crystalline structure of the metal in a finely divided and homogeneous state. A considerable economy is claimed in the use of centrifugal castings by virture of the fact that there is a negligible amount of scrap due to blow-holes in the castings, and that since no sand is used and the surface of the dies is ground, the castings are clean

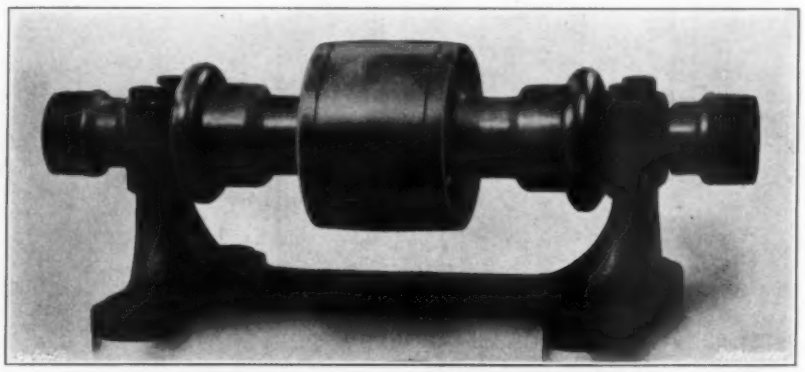


FIG. 61—QUADRUPLEX PUMP WITH FIXED SHAFT

and smooth on the outside and require much finer machining allowances than for sand castings.

It might be thought that the metal of a casting made in this way would be much harder near the periphery than towards the interior, on account of the greater centrifugal effect towards the outside, but samples which we have inspected refute this idea. One, for instance, had a radial thickness of 2in. out of a total diameter of, say, 6in., and along a radius it had been tested by the Brinell method five times at equal intervals. All the tests gave a hardness number of 202. In the case of piston ring pots and similar castings, it is necessary to allow only ¼in. for machining to get a perfectly clean surface for any

diameter from 7in. to 24in., while within corresponding limits in metric sizes the allowance is 1½ mm.

Another interesting feature on this stand is a group of "Die Cast" iron rods, which are specially suitable for such services as the manufacture of moulds for glassware and any other in which a very fine grain is desirable. These rods are cast from a specially selected grade of iron, and are entirely pearlitic in nature—they contain no cementite. It is not possible here to describe in detail the process of making these bars, but it may be said to consist in the pouring of the iron into an iron mould from a considerable height, and allowing the molten metal to run down a shoot so that it enters the mould with plenty of inertia. The result is that any included gases are pounded out of the metal and a very sound ingot is produced. These bars are made in diameters ranging from 1in. up to 6in. and 15in. to 16in. long. They are supplied rough machined, and if a smaller diameter than 1in. is required the surplus metal is taken off in the lathe. These bars are cast in split dies, so a cylindrical result is obtained, but another process has been developed in which four or more solid dies are rotated about a common axis to produce a centrifugal action. The bars thus produced must have a slight taper, to allow them to be drawn, and it is noteworthy that their constitution does not vary throughout their width, as it is measured from the centre about which the several moulds rotate. All the metal used in these processes is passed through a rocking mixing furnace after coming from the cupola, in order to eliminate any gaseous or slaggy impurities and to ensure a consistent mixture. Besides iron, Monel metal, yellow metal and nickel alloy can be cast in this way.

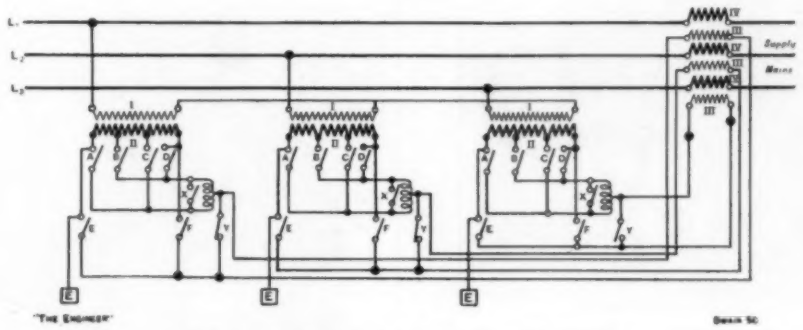


FIG. 62—CONNECTIONS FOR A.C. BOOSTER—HACKBRIDGE

THE HACKBRIDGE ELECTRIC CONSTRUCTION COMPANY, LIMITED.

The demand for alternating-current pressure regulators for boosting feeders and for use on lines interconnecting power stations is steadily increasing, and a regulator suitable for high-tension or extra high-tension circuits is being exhibited by the Hackbridge Electric Construction Company, of Hersham, Walton-on-Thames. As shown in the diagram, Fig. 62, the system of regulation adopted is that involving the use of shunt and series transformers, the former having tappings and regulating switchgear for bringing the various tappings into use, so as to energise the primary windings of the series transformers at various voltages. The contactors on the panel—see Fig. 63—are designed for a pressure of 660 volts and a current of 100 ampères. The positive or negative boost is 200 kVA, reversing contactors being provided to enable the current from the shunt transformers to flow through the primary windings of the series transformers in either direction. The secondary windings I I—Fig. 62—of each phase of the three-phase shunt transformer have tappings which divide the winding into three equal parts, thus giving a boost in three equal steps, each tapping being connected to one pole of the triple pole contactors A, B, C and D. The change over from one tapping to another is made without opening the circuit, as two adjacent contactors may be closed at the same time, the current in the local circuit of the section of the winding affected being limited by intermittently rated choking coils, with a connection at the middle point. When the tapping changing gear is not in operation, however, each of these choking coils is short circuited by a contactor X. E and F are reversing contactors, the former allowing the current to flow through the primaries III. of each series transformer in one direction, and the latter in the opposite direction. The contactors Y are called "normally closed" contactors, and in the event of the contactor operating current failing, they short-circuit the primaries of the series transformers. They are also closed when the equipment is in the normal "no boost position." From the key diagram, Fig. 64, the sequence of operations can easily be followed. Starting from the normal position O, contactors X, A and E are closed, thus enabling the contactor Y to be opened which takes place at the next stage. At the same time the contactor X is opened, and as the choking coils are no longer short-circuited the contactor B is closed, as shown at stage 2. Contactor A is then opened, as shown at stage 3, and, finally, contactor X is closed again at stage 4. The line is now receiving one-third of the full boost, the circuit between the series transformer and one-third of the shunt transformer being completed through contactors B and E, and through the choking coil, which is short-circuited by the contactor X, the other contactors, including the contactor Y, remaining open. The sequence for the other two steps is similar to that for the first step. The operating coils of the contactors are connected to a suitable supply, through the segments on the drum to be seen in the bottom right-hand corner of Fig. 63. Above this drum there are "raise" and lower push buttons, which control the motor for rotating the drum. Obviously the control system could easily be designed for remote operation, say, at a sub-station, and by the addition of a voltage relay connected to the line through a small potential transformer, the panel would be made to operate automatically. The time of operation from one step to the completion of the next step is six seconds. On a 2000-kVA line the equipment will give a 10 per cent. boost.

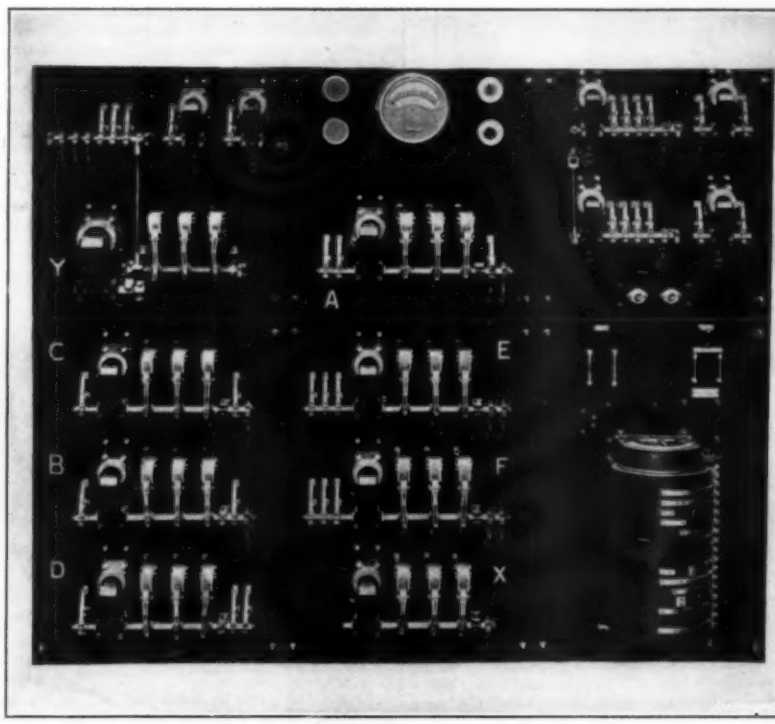


FIG. 63—A.C. BOOSTER CONTACTOR PANEL—HACKBRIDGE

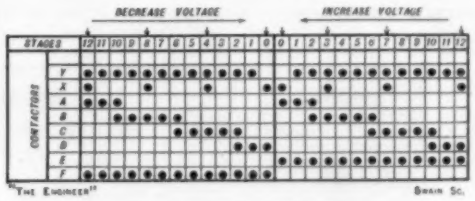


FIG. 64—SEQUENCE DIAGRAM

GEORGE KENT, LTD.

The most novel exhibit on the stand of George Kent, Ltd., of Biscot-road Works, Luton, is a new type of the "Clear View Screen," the broad principle of which we have already described. These screens are intended to be put in wind screens of vessels or motor cars to provide a clear view forward, regardless of the incidence of rain or snow. To this end a disc of polished glass is rotated at a high speed by a small electric motor, and the centrifugal force so produced throws off the moisture sufficiently rapidly to maintain good transparency of the window. This fitment has in the past been manufactured and set up in conjunction with a hood, *a la* binnacle, so that the observer might protect his head in the hood and direct the pane as he liked, so that bearings might be taken in any direction. The new design, which we illustrate in Fig. 65, is intended for fitting in the glass screens of wheel-houses and bridge shelters, where the glazing is continuous. The rotating disc is 13in. in diameter, and as will be noticed the whole arrangement is mounted on a hinged frame, so that it may be swung clear in fine weather. It will also be observed that the gear for driving the disc obscures the view to the smallest possible extent. The remainder of the exhibits on this stand comprise a selection of metering apparatus for the measurement of water, gas, steam, oil and other fluids, among which there are some instruments of comparative novelty.

FIG. 65—CLEAR VIEW SCREEN—KENT

SIEMENS BROTHERS, LTD.

An automatic alarm device, designed to comply with the British draft technical wireless regulations of the Committee of Imperial Defence, and the 1927 Statutory Rules and Orders, is one of the exhibits of Siemens Brothers, of Woolwich. Its function is to give warning of the receipt of an alarm signal on a wave length of 600 m. The alarm signal to which the apparatus responds consists of a series of twelve dashes, sent in a period of one minute, the duration of each dash being four seconds, and the duration of the space separating each dash one second. The complete instrument consists (*a*) of a tuner mounted together with a single valve detector circuit in a single box; (*b*) a two-valve amplifier for amplifying the signals received; and a single valve rectifier for rectifying the signals before passing them on to the relay of the selector. This instrument corresponds with the tuner unit in that it is mounted in a cast metal box with a metal panel. The plate current of its rectifying valve is indicated by a milli-ammeter connected permanently in the circuit, thus enabling the change of plate current for various signals to be

noted. The tuner is adjusted so that it will respond to signals on wave lengths between 585 m. and 615 m., having a steady note frequency of not less than 100 per second, the strength of signals after the valve being comfortably audible to the trained ear. The tuner and amplifying units are shown in Fig. 66. After the first detector and first and second amplifying valve, sockets are provided for testing the instrument by means of head-phones. There are two other units in the selector and the bell. By means of the former the alarm signal is selected from the various signals received on the aerial. The selector consists of a wheel mounted on a shaft, which when a signal is received, engages with a steadily running motor. If the signal

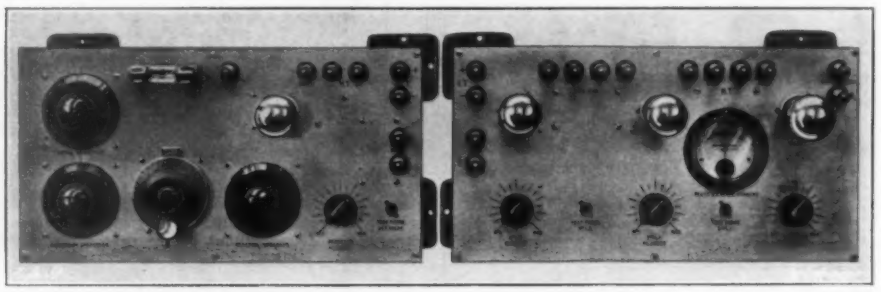


FIG. 66—AUTOMATIC WIRELESS ALARM—SIEMENS BROS.

received is the alarm signal, a contact mechanism bearing on the rotating wheel causes a series of contacts to be made which automatically complete a circuit and cause the bell to ring. If, however, the signal received is not the alarm signal, the contacts are not made, and by means of a releasing arrangement the mechanism is de-clutched from the motor, and is returned to the position of rest. Bells for giving warning are placed in the wireless office, in the wireless operators' cabin, and on the bridge. Arrangements are made so that in the event of any one of the valves in the receiver failing, the bells will ring. The installation may also be tested as a whole in one operation from the aerial to the bells. A key is provided in the circuit, so that the installation can be tested without ringing the bridge bell, but the key automatically closes the circuit to the bridge bell when it is not pressed down for testing purposes. A special main auto-alarm switch changes over the aerial from the main receiver to the automatic alarm receiver and *vice versâ*, and it ensures that for any test on the auto-alarm receiver the aerial must be correctly connected.

THE PREMIER ELECTRIC WELDING COMPANY.

A binary electric welding equipment made under Mr. F. Creedy's patents, is one of the exhibits of the Premier Electric Welding Company, of Abbey Wood, S.E. 2. The complete equipment, which is shown in Fig. 68, consists of a combined alternating-current motor and direct-current generator, and it occupies very little space. The general principle of the machine was described in our issue of March 4th, 1927. The single operator machine exhibited is of the vertical type, but a horizontal equipment is also made. The single-operator welder shown in Fig. 67 is another

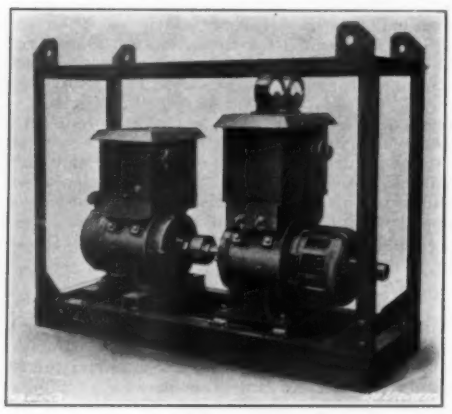


FIG. 67—ELECTRIC WELDING SET—PREMIER

of this company's exhibits. This is a direct-current motor generator welding set with the motor starting gear enclosed in a weatherproof steel case mounted on a cast iron bracket above the motor, the generator switchgear and reactance being similarly enclosed and mounted above the generator. The ammeter and voltmeter are of the weather-proof pedestal type. There is no exposed wiring and no switchboard, and as the motor and generator are of the fully protected type, the whole plant is completely waterproof.

The company has recently introduced a system of welding which is claimed greatly to increase the speed of working when welding long straight seams or when making heavy metal deposits. The rate at which an electrode can be deposited increases with the current consumption and arc voltage. The speed of welding is, however, limited so far as current consumption is concerned, by the amount of current which an electrode will carry without getting red hot. To a considerable extent the arc voltage is influenced by the kind of coating used on the electrode. A new type of "Premier" electrode is in the form of a continuous coil of highly flexible wire, which is wound on a spool or bobbin, the electrode being fully fluxed; in fact, in every respect it is similar to the ordinary "Premier" electrodes at present on the market. The new electrode is not, however, held in an ordinary holder, but is fed through a nozzle attached to a small hand tool, which is either operated by compressed air or electricity. The electrode passes through this nozzle at the required speed, which can easily be adjusted by the operator whilst welding. The outer surface of the electrode is composed of bare wire, and it receives the current from the nozzle through which it passes. As only a short length of electrode projects beyond the nozzle, currents of much greater magnitude than usual can be employed without risk of the wire becoming red hot. The standard electrode is equivalent to a No. 9 gauge wire, and it is said to be quite easy to use currents of 200 ampères or more for welding, and that nearly double the ordinary welding speeds can be obtained. As the electrode tools which are to be seen in operation on

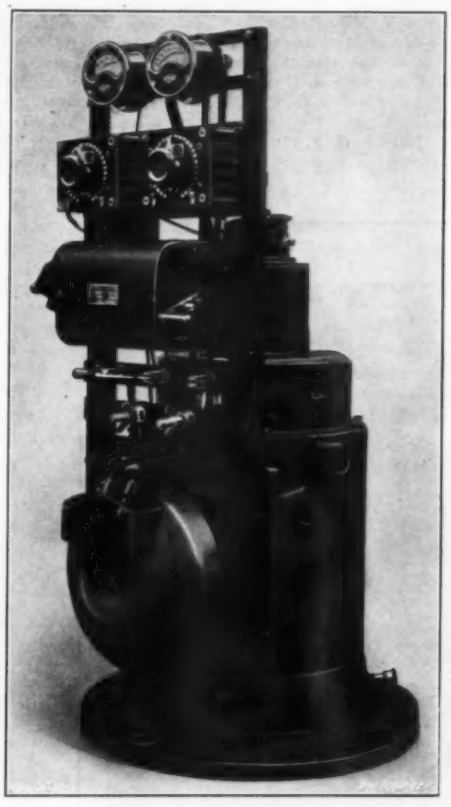


FIG. 68—BINARY ELECTRIC WELDER—PREMIER

the company's stand are not at all expensive, and as the price of the electrode wire is practically the same as that of the company's other electrodes, the new system gives rise to a considerable saving.

THE FOSTER INSTRUMENT COMPANY.

The principal exhibits of the Foster Instrument Company, of Letchworth, consist of electrical radiation pyrometers in which the moving system controlling the indicator pointer or recording pen is provided with the firm's "Resilia" spring mounting, which is designed to protect the delicate pivot points and jewels from damage whilst in service and in transit. Various types of these pyrometers are shown, including a set of instruments for use on board a ship. These instruments are mounted on a support which is subjected to periodical rolling and vibration to correspond with the conditions met with in marine service. The instruments are of the indicating and recording types and they are shown in operation. Thermo-couple pyrometers made by the firm are for the measurement of the temperature in internal combustion engines, particularly motor car and aeroplane engines which operate at high speeds. No attempt is made, however, to measure the variation in temperature during the cycle, but only the mean gas temperature throughout a succession of cycles. This mean temperature has a very close relation to the

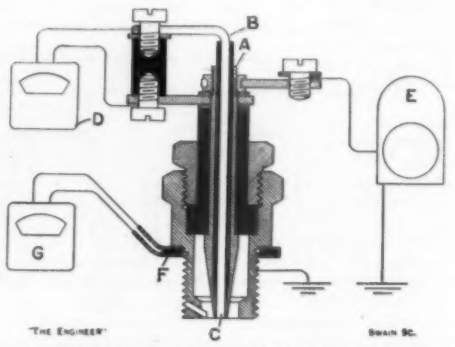


FIG. 69—SPARKING PLUG THERMO-COUPLE—FOSTER

gas distribution amongst the different cylinders, their output and the heat stresses to which the cylinder walls, piston crowns and valves are subjected.

The temperature has been found to have a very close relation to the actual temperature of the head of the exhaust valve, investigations with the instrument having shown that at full throttle and at full load the exhaust valves in practically every motor car and aeroplane engine are red hot. Obviously devices used for measuring the mean gas temperature must not alter the actual conditions existing in the cylinders. Additional projections into the cylinder must be avoided, and with this object in view use is made of the ignition plug, which serves its usual purpose, but in the centre of the plug there is a concentric thermo-couple, which gives a fairly accurate measurement of the mean gas temperature. Originally the thermo-couple took the place of the copper-asbestos washer under the shoulder of the plug, and it was therefore situated outside the cylinder. But whilst this scheme gave an indication of an increase in temperature, it did not give an accurate measurement of that temperature; indeed, in the case of a water-cooled engine the reading was more closely related to the cooling water temperature than it was to the mean gas temperature. With the improved device, however, it is possible, by watching the instrument, to tell exactly what is being done with the throttle of the engine.

The diagram Fig. 69 shows the new arrangement as well as the older washer thermo-couple scheme, the two arrangements having been adopted with a view to making comparative tests, which fully confirmed the contemplated advantages of the sparking plug couple. The centre electrode consists of an outer tube A and an inner wire B joined together at the tip C, but insulated from one another everywhere else. The two elements of the thermo-couple are connected through compensating leads to an indicator D, the connections to the ignition circuit being shown

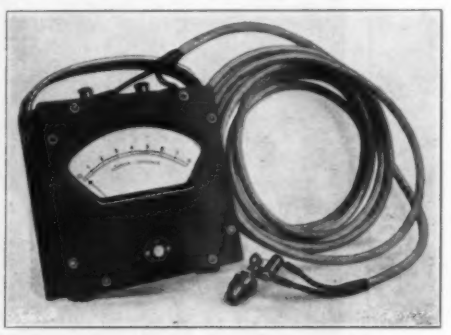


FIG. 70—TEMPERATURE INDICATOR—FOSTER

on the right, where the magneto is to be seen at E. The washer thermo-couple is shown at F and its indicator at G. The actual indicating instrument exhibited is for a six-cylinder engine, and it consists of six miniature indicators all assembled in one case and connected to six separate thermo-couples arranged within the plugs as described. The type of instrument used with a single plug couple is shown in Fig. 70, where the thermo-couple plug is to be seen connected to the instrument leads.

THE CAMBRIDGE INSTRUMENT COMPANY, LTD.

The Cambridge Instrument Company, of 45, Grosvenor-place, S.W. 1, is showing a representative

collection of instruments for use on ships and in engineering works, including electrical CO_2 and CO indicators and recorders, apparatus for recording the percentage of dissolved oxygen in boiler feed water, draught and pressure gauges, temperature measuring instruments, automatic temperature regulators and other instruments for engineering and electrical measurements. There is a complete installation of six illuminated dial CO_2 indicators, which are shown working in conjunction with a CO_2 recorder. These indicating instruments—one of which is shown in Fig. 71—are provided with dials 13in. in diameter, and the actual figure representing the percentage of CO_2 is illuminated by a white light, whilst the pointer in

FIG. 71—CO_2 INDICATOR—CAMBRIDGE

line with it is illuminated by a red light if the percentage is decreasing and by a green light if it is increasing. The position of the illuminated spot on the dial combined with the colour of the pointer thus enables the stoker to gather at a glance valuable information regarding the combustion conditions. The CO_2 percentage is measured by the firm's electrical method, which we have previously described, a feature of the method being that no chemical absorbents or delicate glass work is required. As the instruments are robust and need little attention, they are well adapted for use on board ship.

RANSOMES, SIMS AND JEFFERIES, LTD.

The principal exhibits of Ransomes, Sims and Jefferies, Ltd., of Orwell Works, Ipswich, consist of four types of electric trucks with a carrying capacity of 2 tons. There is a high elevating platform truck with two-wheel steering gear, a low elevating platform truck with four-wheel steering, a truck with a tiering platform capable of raising loads up to a height of 5ft. 1in., and a crane truck fitted with a ½-ton swivelling crane for use where heavy loads have to be lifted on to the platform of the truck. There is also an electric runabout crane which will travel, hoist, derrick, and turn about its centre under its own power. Cranes of this type are made for 7½, 15, 20, 25, and 30 cwt. capacity.

The 1¼-kW charging set shown in Fig. 72 is another of this firm's exhibits. The shunt-wound protected type direct-current motor is coupled to a

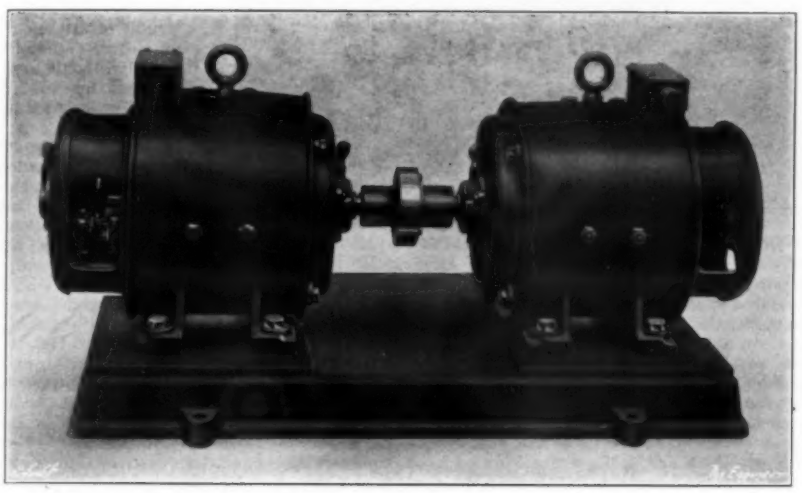


FIG. 72—1¼ KW BATTERY CHARGING SET—RANSOMES

shunt-wound dynamo with an output of 1¼ kW at 40/50 volts, the speed being 1400 r.p.m. The set consists of two standard machines with ball bearings, connected together by means of a flexible coupling. For operating the motor a standard starting panel is employed, whilst the dynamo is controlled by a switchboard with the necessary instruments, including a shunt regulator and automatic cut-out. The plant is suitable for charging a truck battery, and it is being used at the exhibition for that purpose.

THE IGRANIC ELECTRIC COMPANY, LTD.

The Dean electric control gear—see Fig. 74—for the operation of steam, water and gas valves, exhibited by the Igranic Electric Company, of 147, Queen Victoria-street, is claimed to eliminate all the disadvantages of the old methods of electrically operating valves. It avoids all over travel or drift of the valve

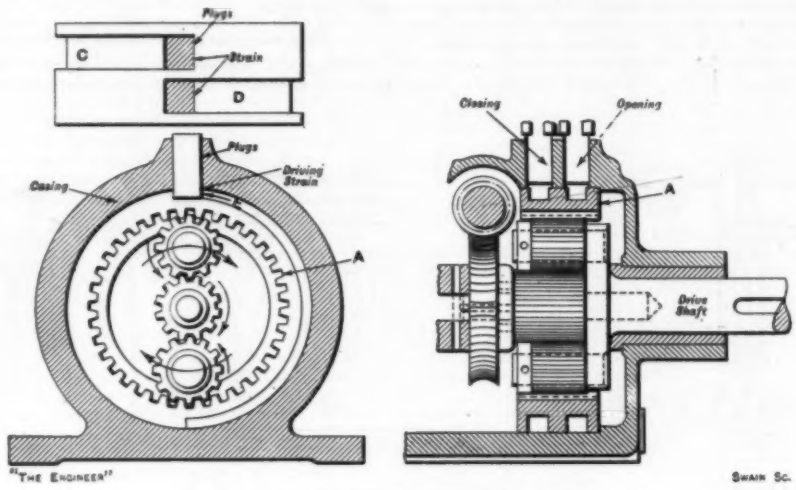


FIG. 73—DEAN VALVE CLOSING GEAR—IGRANIC

gate into its seat, positively closes the valve under power without jamming, and instantly releases the driving mechanism. There are no exposed gears, and there is only one projecting shaft, the whole unit being totally enclosed and as nearly moisture-proof as possible. A reduction gear of the combined worm and planetary type reduces the motor speed and drives the valve stem as shown in Fig. 73. The quick stop and elimination of the effect of inertia are obtained by means of the gear shown in this illustration. The centre pinion is rotated by the motor through the worm and worm wheel, thus turning the planetary pinions and valve driving shaft in the direction indicated by the arrows. The internal gear A is free to revolve on a machined surface in the casing, but it may be prevented from doing so by two plugs, which pass through the casing. The outside surface of the internal gear has two channels C and D on the periphery, one extending half-way round on one side and the other half-way round on the other side. When both plugs are seated in the channels, the internal gear is locked. With the centre pinion

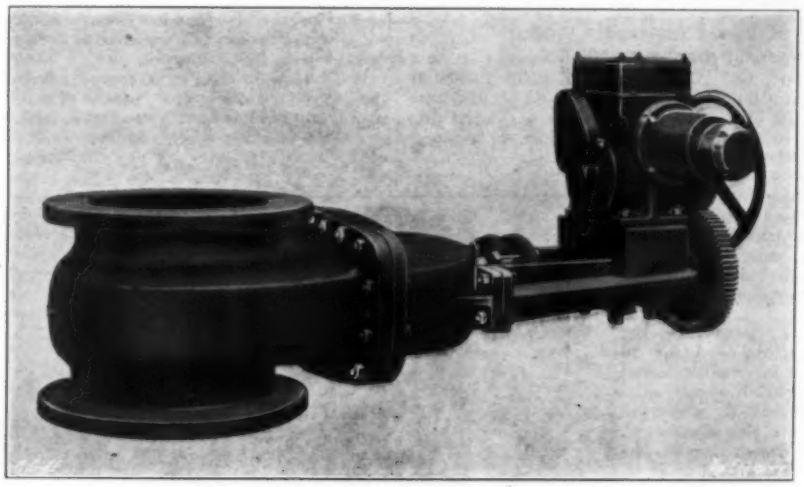


FIG. 74—ELECTRICALLY-OPERATED VALVE—IGRANIC

driven by the motor, the planetary pinions must travel round their own axis and around the internal gear, this being the running condition of the mechanism.

At the end of the travel, the motor circuit is opened and the restraining plug is removed so that the drift is taken up by the rotation of the internal gear. Assuming that the valve is closing and the plug is restraining the movement of the internal gear, at the instant the valve is tightly closed the motor is disconnected, and the closing plug is quickly withdrawn from the slot, thus allowing the internal gear to revolve and absorb the inertia of the driving mechanism, and in this way the motor drift is provided for. The operating plug in the other channel provides the blow for unseating the valve. The lost motion mechanism is so designed that the motor comes to rest before the internal gear has travelled half a complete revolution,

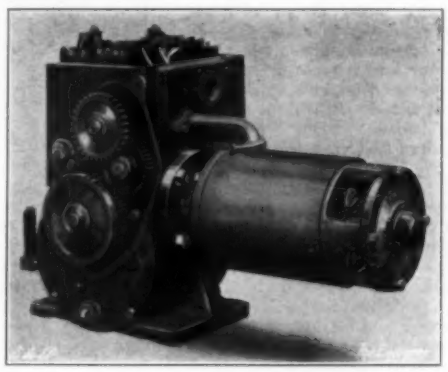


FIG. 75—VALVE OPERATING GEAR

and the opening plug does not interfere with this motion, but moves along in its channel.

During the opening of the valve the motor is reversed and the internal gear moves nearly one-half a revolution before it is restrained by the opening plug. Sufficient time is therefore allowed for the motor to accelerate before the valve actually opens, and this provides the blow that is often necessary to open a tightly seated valve. When this control gear is properly adjusted, the valve will always close to exactly the same point irrespective of whether pressure is on the gate or not, or whether the gland is loose or tight. The same system of electrical connections serves for alternating and direct-current circuits, and the motor can be changed to suit the supply in a few minutes. Fig. 75 shows the motor operating gear detached from the valve.

Empire Engineering Company.

The exhibits of the Empire Engineering Company (Manchester), Ltd., Clarendon-road, Salford, include lubricators of many types, two of which we illustrate in Figs. 76 and 77. Fig. 76 shows the Empire "direct" lubricator in section. This appliance is specially adapted for use on Diesel and semi-Diesel engines, but is also applicable to engines of other kinds. Simplicity of construction and operation are the special features of this lubricator. In the illustration it is shown arranged for a direct lever drive, the lever moving through an arc of about 20 deg. This lever is connected to a shaft which operates the rocking levers B, which in turn operate the plungers C. The oil is drawn through the suction valves D and upwards through the nozzles E. After leaving the nozzles the oil flows up the guide wires G in the sight-glasses, which are filled with water, and passes through the valves H to the points of delivery. The oil-feed is regulated by means of the regulators J, which govern the movement of the rocking levers, and it is quite possible to deliver a drop of oil for every stroke of the engine down to zero. These lubricators are also made with pulley and ratchet-drives for high-speed engines, and they are fitted with bull's eye sight-feeds when working against high pressures.

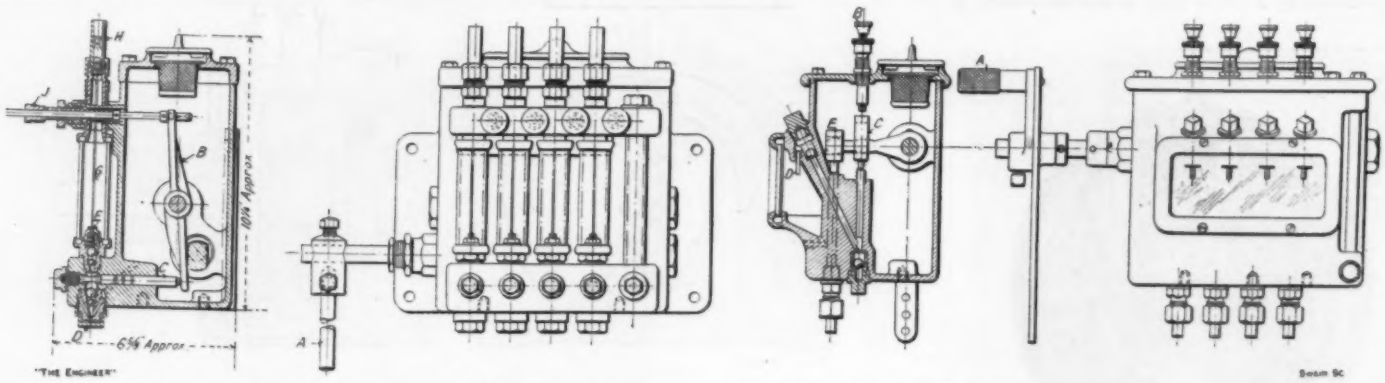
Fig. 77 is a sectional view of the Empire twin-plunger lubricator, which is applicable to steam, gas and oil engines. In the illustration the lubricator is shown fitted with a direct-lever drive. It is also fitted with a lever A, so that the engine can be flushed before starting. The flushing buttons B over the feeds are provided for flushing each individual feed, should this be desired. The action of the lubricator is as follows:—The first or suction plunger C serves to pump a supply of oil through the nozzles or delivery tubes D seen in the illustration. The oil falls from the nozzles into the proper compartment below. It is then drawn into the delivery pump chambers by the upward movement of the second or delivery plungers E, and is finally forced to its destination on the downward stroke of these plungers. This lubricator, it is stated, is unique in so much as it delivers oil at every movement of the actuating lever, which is a valuable feature for explosion engines. It is also arranged with a roller-clutch drive for high-speed engines.

The Godfrey Engineering Works.

During the course of most of the engineering exhibitions which have taken place during the past few years, it has been our province to make some reference to the oxygen blow-pipe cutting machines made by the Godfrey Engineering Works, of Boundary-road, Wood Green, London, N. 22, and it is not consequently necessary to comment at any great length on the new model illustrated by Fig. 78, but it appears that this machine is even more "universal" than its prototypes.

The cutting of steel is, of course, effected by burning away a narrow slot, by means of a jet of oxygen after the metal has been heated up to such a temperature that it will readily combine with the oxygen, and consequently provide heat to continue the reaction. Such a process is now well recognised; but in the case of the Godfrey machines the cut seems to us to be as clean as may be. The cleanness of the cut is, however, not only dependent on the form of the blow pipe itself, which is all-important, but also on the regular progression of the "flame" along the cut, regardless of the contour which must be followed.

In the case of simple geometric forms, this condition is easily attained, as the blow pipe, carried by a doubly articulated arm, is controlled by a pair of slides, much in the same fashion as the tool of an engine lathe. The feeds of these two slides are operated by a compound gear-box, driven by a small electric motor, and can be so compounded to produce a variety of movements. When, however, more irregular shapes, such as the side frames of locomotives, have to be cut out, there is a liability for the rate of progression to vary, especially as the blow-pipe goes round a corner. Then a special form of template is adopted to guide the point. This template may be built up in any convenient way from pieces of wood which can be accurately shaped, and against it there bears a rubber covered roller driven from the actuating motor. This roller is attached to an upward extension of the blow pipe and feeds the head forward, round the template, at a speed only dependent on the continuous running of the electric motor. Along such parts of the pattern where complicated curves need not be followed the template can be greatly simplified. A special machine for making templates from three-ply wood, which may individually measure as much as 7ft. long by 2ft. wide, has been devised by the makers.



FIGS. 76 AND 77—SIGHT-FEED MECHANICAL LUBRICATORS—EMPIRE

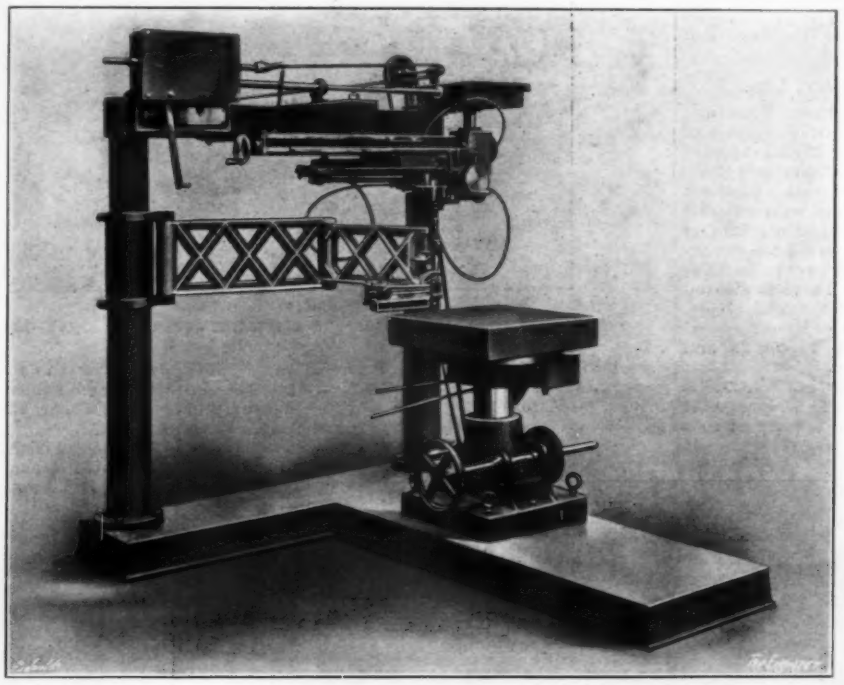


FIG. 78—UNIVERSAL OXYGEN CUTTING MACHINE—GODFREY

In the case of circles, the blow pipe is carried by a radius arm, which is pivoted at the centre of the table, and the work is rotated by the table. The machine will cut squares from 1in. by 1in. to 3ft. by 3ft., by means of an automatic trip action on the feed slides, while circles up to 3ft. in diameter can be cut with the aid of a radius arm. The rotating table, which also serves as an adjustable work table can be moved to any position relative to the machine, so that discs up to 12ft. diameter and over can be cut. A mandrel fits into the centre of the table, whereby collars, cams, &c., can be quickly made. This mandrel is arranged to carry a template at the top, therefore irregular shapes can be cut on the table. Underneath the table there is a division plate which enables the operator to cut large square, or hexagon, nuts and other pieces without a template. This table will carry a weight of 8 tons. The blow pipe, using dissolved acetylene, will cut any thickness of steel up to 10in.; it is specially designed for machine cutting, and can be tilted to any angle up to 45 deg. It does not harden the cut faces or injure the work in any way, and is very economical in the consumption of oxygen. In addition to the valves for adjusting the heating flame, there is a lever which will cut off the heating flame and the cutting oxygen at the same time without interfering with any adjustment. All the valves have graduated dials, so that exact and known adjustments can be instantly made.

It is noteworthy, in view of the controversy which has raged round the subject of preheating the oxygen used in a cutting flame that, in consequence of the high degree of purity now obtainable in commercial oxygen, the Godfrey Company has abandoned the idea of preheating as being unnecessary.

eye is very easily deceived, and there is practically no remedy for his mistake.

In the original acid Bessemer process the requisite heat was furnished by the combustion of the 2 to 2·5 per cent. of silicon present in the pig. But to avoid the rapid destruction of the basic lining the silicon must not exceed 1·0 per cent., and as phosphorus gives out less heat when burnt than silicon, the pig must contain in addition 3·0% P, 99 hundredths of which must be eliminated in about three minutes. The pig required for the basic Bessemer process must be more accurate and regular in its composition than that required for any other process.

The preliminary difficulties were very considerable, but by 1880 passable steel was being produced in commercial quantities in Messrs. Bolckow Vaughan's works in Middlesbrough, although the Cleveland ore was too siliceous to give the best results. Much of the material when first produced was most uncertain in quality, one sample soft and ductile, the next as brittle as glass. As late as 1890 the writer saw two instances of such material, made in two well-known works, behave in a most disconcerting manner. Cart-loads of mild steel bars, 1¼in. diameter by 30in. long, were tipped out on to a wood floor, and some in each consignment broke in two under this light shock. The fractures were quite sharp, and exhibited very large crystals, such as are commonly seen in spiegel pig.

At its best the process is only suitable for making very low carbon steel, which may not prove unduly brittle with 0·07 or even 0·10 P, provided C is below 0·10 to 0·12, but, of course, such material can have only a low tensile strength. Steel high in carbon, made by this process, is quite unreliable, and though giving satisfactory extension may fail under shock. The writer has a lively recollection of the uncertainty whether tram-rails made by this process would pass the drop test. Some which did, and were apparently sound, broke when being unloaded.

The unreliability of basic Bessemer steel has induced the British steel makers to dismantle their basic Bessemer vessels and discontinue its manufacture entirely, but it is still worked largely on the Continent. In Luxemburg and in Lorraine, which Germany took as a prize after her successful war with France in 1870, there existed, close to the surface, vast deposits of oolitic ore, known locally as Minette, containing 1·5 to 2·0 per cent. P. Some was siliceous, some had an excess of lime, but when mixed they formed a self-fluxing material, exactly suited to make a pig ideal for the newly discovered process. Ample supplies of good coking coal existed; there was an army of trained chemists, and a docile agricultural population accustomed to working long hours for very low wages. The Government gave low freights on the cheaply constructed State Railways, and the bankers found the capital to start Germany upon a successful career as a maker of steel, with the benefit of the experience acquired, at considerable cost, by Great Britain and America during the preceding twenty years. Many very fine plants were put down, capable of producing far more steel than there was a demand for. The capital of some German companies had to be cut down drastically; all sorts of "cartels" were tried to limit production; material was dumped abroad at any price it would realise, and the steel trade of Europe has been in an unsatisfactory condition ever since. Then came the Great War, which accentuated the difficulties of the steel trade in this country more than in any other.

Before the war the annual output of steel in Great Britain was 7½ million tons; in France, 4½ millions; and in Belgium, 2½ millions; making 14½ million tons produced by the Allies. Germany, which was making 19 million tons, and controlled the Austrian make of 4½ millions, seized all the works in Belgium, in Luxemburg which made one million tons, and in France plant capable of making 3 million. She then held plant capable of producing over 28 million tons, leaving to us and our Allies a possible production of only 9 million tons.

Soon the Allies were absorbing half our make of steel, and before the end of 1916 the British Government saw that the output of steel in this country must be increased. The British steel makers agreed to enlarge their plants on the understanding that part of the cost of such extensions should be set off against the Excess Profit Duty to which they were liable, and on this understanding plans were prepared for additional plant capable of raising the British output to 14 million tons. Some of these extra plants were never completed, and others never worked, but an output at the rate of 12½ million tons was actually attained before the men had to be withdrawn to serve at the front. In the earlier stages of the war our Allies were supplied through us from the United States, where the output of steel went up from 31 million tons in 1913 to 45 millions in 1917.

During the war the French increased the capacity of such of their steel works as were not in the hands of the enemy and erected others: both they and the Belgians have reconstructed, in an improved form, at the enemy's expense, those plants deliberately damaged by him, so that they are now in a better position to compete with us than they were in 1913. Owing to the depreciation of the mark German works paid off debentures and similar loans at purely nominal cost, escaping altogether the liability to provide for capital charges of this nature. All the continental workmen are working longer hours than ours for lower wages still paid in depreciated currency. Nor is there any immediate prospect of British steel finding an outlet abroad. Canada, India, Australia, and even South America, like most countries in the world, are endeavouring more or less successfully to build up a steel industry within their own borders. Exporters had been looking to China, which has a population three times that of the United States, with a negligible steel plant, but with a civil war in progress, which shows no sign of ending, there is little to be hoped from that country for some time to come. Furthermore, America and Japan are nearer to China and likely to get the largest share of what is to be had. As for Russia, with a population not far behind that of the United States, nothing is to be expected. If with a settled Government and a united people we are still suffering heavily from the effects of the war, there seems no possibility of Russia, still suffering from a revolution, being of much account for a generation to come.

With an output capacity approaching 14 million tons, a pre-war output of 7½ million, it is evident that the less well-equipped works in this country must go out of use, as occurred after the Napoleonic and Crimean Wars. The offer of a bonus to the consumer, to enable the survivors to reduce their dead expenses by keeping the better plants in full work seems almost the only course open to the British steel trade at the present juncture.

Consumers should realise that the steel for constructional purposes purchased on the Continent is practically all basic Bessemer steel, and not the same as that made in this country. For thirty years past the writer has resolutely refused to accept basic Bessemer steel, wherever made—except occasionally for a small roof—and it is a satisfaction to know that none is now made here. During the recent coal strike he was compelled to use continental steel for important structures, and decided to re-design the work, providing for considerable increase in weight for such parts of the structure as had to be made from continental steel, when British material was not obtainable, and it is well he did so. The British steel had given consistent results throughout; all had a tensile strength of well over 28 tons per square inch and an extension before fracture of well over 20 per cent. The continental material, certified to have been tested and to have passed the British Standard Specification, which requires 28 to 33 tons with 20 per cent. extension, when re-tested in this country was found to vary considerably. Some specimens gave a tensile strength as low as 24·7 tons, and in some instances the extension was as low as 14 per cent.

This disconcerting variation in the quality of basic Bessemer steel is readily understandable. The pig from which it is made must be very high in P, or there will not be enough heat generated during the blow, which lasts only twenty minutes altogether, during the last three minutes of which 99 per cent. of the deleterious P has to be removed, the critical period, upon which the success of the operation entirely depends, lasting but a few seconds. The composition of the charge is varying all the time, so it is natural that it should vary considerably at different points at one and the same instant. It is surprising that worse results are not common with such a touch-and-go process.

These objections do not apply to the basic open-hearth process worked in this country. Some of the finest steel made is obtained by treating in a basic hearth a pig rather too high in P for an acid process. Pig containing 0·1 P worked with a basic slag can be relied upon to give with certainty and regularity steel with 0·02 to 0·03 P. In the basic open hearth even high phosphorus pig will yield low phosphoric steel. The first slag high in P is removed and a purer one formed. The process occupies several hours, and there is ample time for the workman to tell by his button when the P is sufficiently low. A melter accustomed to working an acid-lined furnace finds some difficulty, when he first charges over to a basic-lined one, in distinguishing when he breaks his button between a fracture showing the presence of C and that of P, but he very soon gets into the way of recognising the difference. But there is sufficient time to have this checked by a rough analysis, which can be made in twenty minutes. There is no difficulty in producing by this process steels high in C and at the same time low in P, and with such leisurely changes in the composition of the bath its analysis varies very little from one spot to another.

The prejudice still persisting in some quarters against any basic process is due to unfortunate experience with the basic Bessemer, but there is no justification for regarding material produced on a basic open hearth with such suspicion. At one time the basic open hearth was employed to purify material intended to be finished on an acid hearth, but it has been found that it is quite possible to get equally good results by finishing it in one operation.

AT midnight on August 11th Toronto's "new" Union Station, which for eight years has lain idle because of difficulties surrounding the erection of a viaduct in connection with it, was opened to the general public, and the old station, which has served as a terminal for more than fifty years, was closed.

The Electrically-propelled Passenger and Cargo Liner California.

IN view of the fact that the first British-built passenger liner propelled by turbo-electric machinery is now under construction for the Peninsular and Oriental Steam Navigation Company at the yard of Alexander Stephen and Sons, Ltd., of Linthouse, Glasgow, considerable interest attaches to the American liner California, which will shortly be launched and is claimed to be the largest electrically driven passenger vessel in the world. In this article some particulars of the California and her sister liner are given, and on page 282 we reproduce illustrations of the main propelling motors, which have recently been placed in position in readiness for launching the vessel.

The passenger and cargo liner California, which earlier in the year was referred to by Lord Kylsant as being one of the most interesting ships yet constructed, will be launched from the yard of the Newport News Shipbuilding and Dry Dock Company at Newport News, Virginia, at the beginning of next month. As the engravings on page 282 show, the vessel is well advanced and her main propelling machinery has now been installed.

The California is the first of two similar ships which have been ordered by the International Mercantile Marine Company, of New Jersey, for its associated company, the Panama Pacific Line, and are to be constructed at the same yard. It is understood that a third vessel is contemplated, the plans for which have not as yet, however, been made known. The cost of the three ships will, it is stated, represent an investment of over four million pounds. The service on which the new ships are to be employed is an intercoastal one between New York and San Francisco *vid* Havana and the Panama Canal, equivalent to a run of 5500 miles. It is hoped that the California will enter this service early in the coming year. The principal interest in the ship centres in her turbine electric propelling machinery and auxiliaries, which have been designed and built by the General Electric Company, of Schenectady, N.Y. This company, it will be remembered, was the one which constructed the first electrically propelled naval vessel for the United States Navy, and has since designed and installed the propelling machinery equipment for four American battleships and the two American aircraft carriers Saratoga and Lexington. Particulars of the machinery of the Lexington were given in the Seven-day Journal of our last issue.

In general the design adopted for the California follows closely that of the earlier ships, but all the most modern improvements, both as regards main turbines, generators and motors, as well as auxiliary machinery, have, we understand, been incorporated in it.

HULL AND MACHINERY PARTICULARS.

In the following table we give a synopsis of the principal hull dimensions and machinery particulars:—

Overall length	601ft. 3in.
Breadth moulded	80ft.
Draught	30ft.
Gross tonnage	22,000 tons
Displacement	31,000 tons
Designed speed	18 knots
Type of propelling machinery	Twin-screw turbo-electric
Normal motor power per shaft	6750 S.H.P.
Max. continuous motor power per shaft	8500 S.H.P.
Number of turbo-generators	Two
Rated output of each generator	5250 kW, 3700 volts, 3-phase
Generator speed	2640 r.p.m.
Max. continuous output of each generator	6600 kW, 4000 volts, 3-phase

Steam will be raised in oil-fired boilers and the ship, which has two funnels and two masts, will present a handsome appearance. As our illustrations show, the California is being built on a berth spanned by a gantry with travelling cranes, and the work on her will be carried forward on the launching ways until the height reached precludes the further lifting of weights to her uppermost deck. The machinery is now all installed and most of the woodwork accessories and fittings for the cabins and public rooms have been put aboard, so that when launched the vessel will be in an advanced condition. She will be completed at the firm's fitting-out basin, and it is expected that the official trials will be run over the Delaware breakwater course towards the end of the year. The order for the California was placed in July, 1926, and work on her was begun in that month. It is understood that the progress made to date compares well with the practice of good British yards in which vessels of similar tonnage and finish are built.

In America comparisons have been drawn between the California and the privately owned American Atlantic liners St. Paul and St. Louis, which were withdrawn from cross-Atlantic service in 1922. The St. Paul was a 10,230-ton ship with a length of 554ft. and a beam of 63ft. She was propelled by triple-expansion steam engines rated at an output of 20,000 I.H.P. and 18,000 S.H.P., which latter horse-power rating is roughly equal to that of the California. It is pointed out that whereas the St. Paul required 240 tons of coal for a day's steaming of twenty-four hours, the California will only require on a conservative estimate about 150 tons of oil, which may be approximately compared with 195 tons of coal.

The California, when running at her contract speed of 18 knots, should reduce the duration of the voyage between New York and San Francisco by three days. At sea her normal service speed and allowing for calls at Havana and for passing through the Panama Canal it is estimated that two days will be saved on the voyage between New York and the Californian ports.

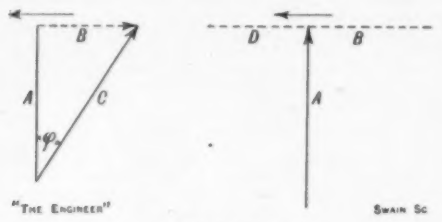
THE Institution of Electrical Engineers has this year made a grant of £1000 to the British Engineering Standards Association.

Condensers for Power Factor Correction.

No. I.

In order that electricity may be sold at the lowest possible rates it is essential to utilise plant and mains to the best advantage. Idle or wattless currents which perform no useful work, but which have a detrimental effect upon the capacity of alternators, transformers and cables, must not be allowed to attain undue proportions; in other words, the power factor of the system must be maintained at a reasonably high value. What the term power factor means still seems to be a mystery to many power users who are now often charged for current on the kVA basis. A consumer whose load has a bad effect on the power factor actually pays more for his power than one who only adds to the wattless load to a relatively small extent. To make the reason for this system of charging clear is not always an easy task, and the need for power factor correcting devices is not generally understood. For the benefit of those who are not electrical engineers and who may have experienced difficulty in grasping the technicalities of the subject we will consider the matter on elementary lines.

On direct-current systems the power factor is always unity, because the current never lags or leads with respect to the electromotive force; hence the product of the volt and ammeter readings always represents the true amount of energy expended in the circuit. But on an alternating-current system the current may lag or lead with respect to the pressure and the product of the current and voltage under these conditions does not represent watts. As a rule the current lags behind the pressure, a condition brought about very largely by induction motors. The current supplied to these motors, and in fact to all inductive apparatus, is made up of two components, a component in phase with the pressure—the energy component—and a magnetising current which is 90 deg. out of phase with the pressure. If the line A in Fig. 1 represents the energy current in phase with the voltage and the line B the magnetising current 90 deg. out of phase with it, then the line C



FIGS. 1 AND 2

will be the total current which lags behind the pressure by the angle φ. Clearly the smaller the component B the more nearly will the total current be brought into phase with the pressure, with the result that the difference between the true watts and apparent watts will be reduced. By eliminating the component B altogether the current would be brought completely into phase with the pressure, when the true power would be given by the product of the volt and ammeter readings.

The power factor of a circuit may be read directly from a power factor indicator or it may be calculated. A watt meter gives true watts; that is to say, it takes into account the angle of lag or lead between the current and pressure, whilst volt and ammeter do not. If it be assumed that on a 500-volt single-phase circuit a current of 100 ampères is found to be flowing, the apparent load would be $\frac{500 \times 100}{1000}$ = 50 kVA.

To find the true kilowatt load, however, we must either multiply the figure by the power factor obtained from the power factor indicator or obtain it from the reading given by a watt hour meter. If during a period of one hour the unit meter records 40 units, then the true load is 40 kW and the power factor $\frac{40}{50} = 0{\cdot}8$.

For any given circuit $\cos \varphi = \frac{\text{kW}}{\text{kVA}}$

$$\sin \varphi = \frac{\text{Wattless load}}{\text{kVA}} \qquad \tan \varphi = \frac{\text{wattless load}}{\text{kW}}$$

If I is the total current represented by the line C in Fig. 1, then the wattless current is given by I sin φ and the useful current by I cos. φ. In the single-phase circuit just mentioned with a load of 50 kW at unity power factor the total current of 100 ampères would become 111 ampères at 0·9 power factor, 125 ampères at 0·8, 143 ampères at 0·7, 167 ampères at 0·6, and 200 ampères at 0·5 power factor, the wattless components being 48·3, 75, 101·1, 133·6, and 173·2 ampères respectively. The capacity of generators, transformers and mains is therefore adversely affected by a low power factor. If a generator is rated 5000 kW at 0·8 power factor (*i.e.*, $\frac{5000}{0{\cdot}8}$ = 6250 kVA), at 0·5 power factor it can only handle 6250 × 0·5 = 3130 kW.

From these elementary considerations it should be clear to all power users, irrespective of whether they have electrical knowledge or not, that from the point of view of electricity supply undertakings high power factor is desirable. Although idle or wattless currents perform no useful work, but merely circulate between the motors and generators, they heat up the generators, cables and transformers and impair regulation. At 0·7 power factor the carrying capacity of all conductors must be 43 per cent. greater than they need be at unity power factor.

Motors are available that do not lower the power factor, such as synchronous motors, auto-synchronous motors and "no-lag" motors. The ordinary synchronous motor, which derives its magnetising current from a direct-current exciter and not from the alternating-current mains, has the disadvantage that it must be run up to speed and synchronised; hence, generally speaking, it is unsuitable for ordinary use. Synchronous three-phase motors can, however, be made to run up to speed without the aid of a starting motor by the provision of a squirrel-cage winding on the rotor, but they will not start with very heavy loads. The auto-synchronous motor is now frequently employed, because it can be started as a slip-ring induction motor. When it has been brought up to speed it is excited with direct current, when it runs as a synchronous motor with unity or a leading power

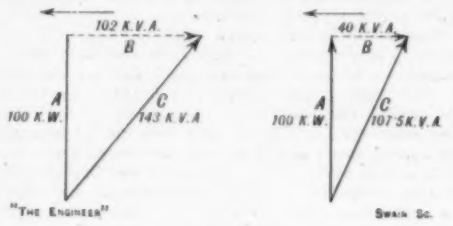


FIG. 3

factor. Many motors of this kind are now in operation. The effect they have on the power factor of the supply system is decidedly good, but they are not made in small sizes and they naturally cost more than ordinary induction motors. "No-lag" motors are constructed for relatively small outputs; they are easily started and, as the name implies, they do not draw a lagging current; but, unfortunately, they are also more costly than the simple induction motor, particularly a squirrel-cage motor of corresponding output. Existing slip-ring motors may be fitted with phase advancers, which supply magnetising current to the rotor at the slip frequency, thus eliminating the wattless component ordinarily drawn from the line. Synchronous motors are sometimes run light on alternating-current lines, particularly long-distance overhead lines, solely for the purpose of correcting the power factor. When used in this way they are called synchronous condensers, their function being to draw the leading currents which, as we shall now show, compensate lagging currents. Every case of power factor correction must be considered individually. No hard-and-fast rules can be laid down as to the best method to adopt and whilst the static condenser method now under consideration often meets the requirements admirably, the other methods must not be overlooked. In all cases power factor correction involves additional outlay, but it can frequently be shown that when a consumer pays for power on the kVA basis the installation of corrective devices results in a handsome saving.

If a condenser of suitable capacity be connected across the terminals of a motor or across the mains supplying a number of motors, the power factor can be raised to unity, although on account of the amount of capacity required it is more usual to employ a condenser that will bring the power factor up to a value somewhat below unity. When connected in this way the condenser takes a current which is 180 deg. ahead of the lagging component, as shown at D in Fig. 2, and if this current is equal to the lagging component B the former will completely neutralise the latter, thus bringing the pressure into phase with the working current A. The angle φ in Fig. 1 will disappear and the power factor will become unity. As the cost of a condenser to improve the power factor from 0·9 to unity is practically the same as that needed to correct from 0·7 to 0·9, it is not usual to attempt to raise the power factor above 0·9 or 0·95 save under exceptional circumstances.

To take a practical example of power factor correction we will assume that the true load is 100 kW and the apparent load 143 kVA. The power factor is therefore $\frac{100}{143} = 0{\cdot}7$.

We will suppose that it is required to raise the power factor to 0·93. The leading kVA required or the capacity of the condenser can be calculated from

FIG. 6—LOWERING CONDENSER FRAME INTO CASE

k W (tan. φ_1 − tan. φ), where φ_1 is the original angle of lag and φ the required angle. The angles corresponding to cos. φ = 0·7 and cos. φ = 0·93 are 45 deg. and 21 deg. respectively, the corresponding tangents being 1 and 0·3839. Thus we have

Condenser kVA = 100 (1 − 0·3839) = 62 kVA (approx.).

The wattless or reactive component in the former case was 143 sin. φ = 143 × 0·714 = 102 kVA, and in the latter case 102 − 62 = 40 kVA.

The original and new conditions are shown in the diagrams Fig. 3, where it will be seen that the 62 kVA condenser has reduced the load from 143 to 107·5 kVA, approximately 25 per cent.

In order to indicate how the installation of a condenser may save a consumer who pays for power on the kVA of maximum demand, we will suppose that a three-phase, 50-cycle, 500 kW load has a power factor of 0·7, the apparent load therefore being $\frac{500}{0{\cdot}7}$ = 715 kVA. With a 350 kVA condenser the load becomes 526 kVA and the reduction in the demand is therefore 715 − 526 = 189 kVA. If the consumer is charged on the basis of £5 per kVA of maximum demand per annum the saving brought about by the condenser will be 189 × £5 = £945, which is sufficient to pay the capital cost of the condenser in less than two years.

As the name implies, a static condenser has no moving part. It requires no attention and it can be placed in any convenient position without the provision

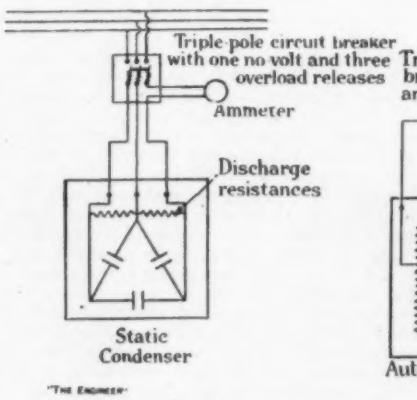


FIG. 4—CONDENSER CONNECTED ACROSS MAINS

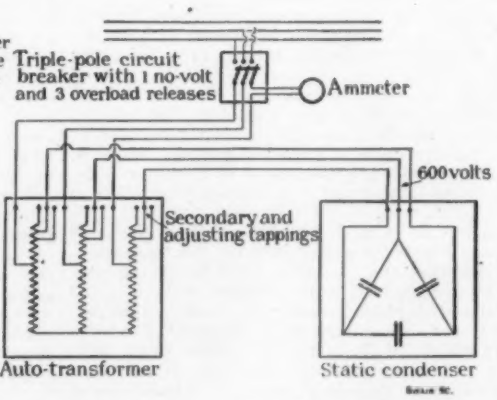


FIG. 5—CONDENSER WITH AUTO-TRANSFORMER

of special foundations. Once it has been installed it rarely, if ever, requires attention, but if, as the result of modifications to the plant, it becomes desirable to correct the power factor at another part of the installation, the condenser can easily be shifted to a new position where its effect will be more pronounced. Generally speaking, it is desirable to place condensers as near as possible to loads which lower the power factor, because in this way the wattless currents in the mains between the load and generators are reduced. Power factor correction at the generating station is only beneficial so far as the generators are concerned, the transformers and mains still having to deal with the wattless load. Condensers may be directly connected across the stator terminals of individual induction motors, when they are discharged through the windings when the motor switch is opened. The same applies to a condenser con-

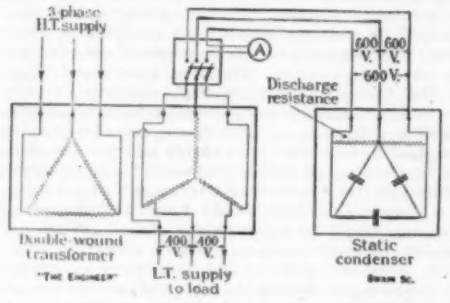


FIG. 7—OVERWOUND TRANSFORMER AND CONDENSER

nected across a transformer where here again both would be controlled with the same switch. When, however, a condenser is connected across the main distributor board or a sub-distribution board supplying a group of motors, a separate switch must be provided for the condenser. For the control of condenser equipments of 50 kVA and upwards the Telegraph Condenser Company, which has made a considerable number of condensers for power factor correction, recommends an oil break circuit breaker, but for condensers below this output an air break switch with fuses will generally suffice. Overload protection is desirable on all phases, and in the case of circuit breakers a no-volt release and ammeter are advocated. It is essential in the case of condensers that are directly connected across the supply, as in Fig. 4, to have some means of discharging the condenser and on all low-tension equipments the Telegraph Condenser Company fits a standard discharge resistance

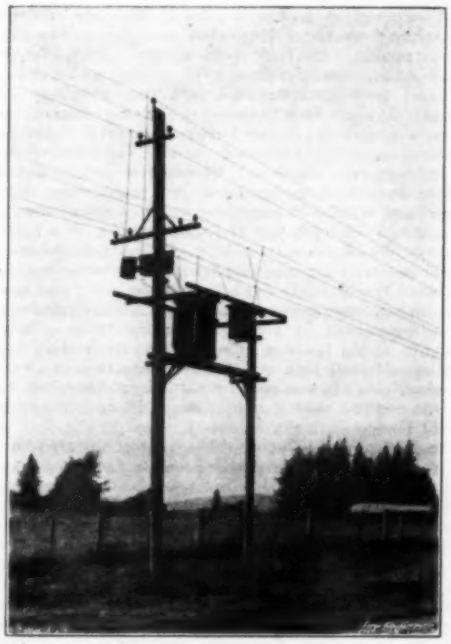


FIG. 8—POLE TYPE CONDENSER

of high ohmic value which is permanently connected across the terminals inside the condenser tank. In the case of a condenser working with a step-up auto-transformer, however, as shown in Fig. 5, the condenser will discharge through the transformer windings.

The condensers made by the Telegraph Condenser Company, of London, are composed of so-called Mansbridge plates consisting of lengths of paper, coated with tin, in accordance with the Mansbridge process. These plates are separated by paper of the requisite thickness, this paper forming the dielectric, the number of strips and thickness of the paper depending upon the voltage applied across the terminals of the condenser unit. As a rule each unit of the condenser has a capacity of 1 microfarad, but it may be more or less according to circumstances. The units are assembled in frames as shown in Fig. 6, and the frames are fitted into tanks, composed of boiler plates, which are completely filled with oil. The most economical pressure for these condensers has been found to be about 600 volts, but condensers have been built for direct connection to systems working at pressures up to 3000 volts. As the efficiency of a static condenser is about 99·7 per cent., the losses are almost negligible. A bank of directly connected condensers having an output of 1000 kVA would only give rise to a loss of 3 kW. When, however, auto-transformers are used for increasing the voltage to the most economical pressure for the condenser, the transformer losses must, of course, be taken into account; but even in these cases the overall loss of a large equipment is only 1 to 1·5 per cent. of the kVA output. The output of a condenser is directly proportional to the plate area and inversely proportional to the dielectric thickness which is mainly dependent upon the voltage across the plates. The capacity

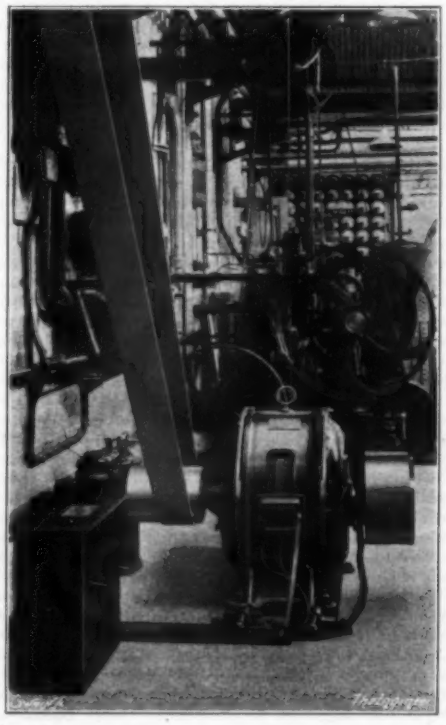


FIG. 10—CONDENSER CONNECTED ACROSS MOTOR

of a condenser in microfarads for a specified kVA is given by

$$\frac{\text{kVA} \times 10^9}{2\pi f V^2}$$

where kVA is the output of the condenser, V the voltage applied across the plates, and f the frequency of the supply. A 600-volt, 100 kVA, 50-cycle condenser would have a capacity of

$$\frac{100 \times 10^9}{6{\cdot}2831 \times 50 \times 360{,}000} = 885.$$

At 440 volts the capacity would be

$$\frac{100 \times 10^9}{6{\cdot}2831 \times 50 \times 19{,}360} = 1650$$

The condenser required for the lower voltage would naturally be a good deal more costly than that required for the higher voltage, and in such cases it is advisable to increase the pressure by means of an auto-transformer to the most economical value for the condenser. As an auto-transformer is not an expensive piece of apparatus, the overall reduction in the price of the complete equipment is considerable. By utilising Dorey's patented method of overwinding a main transformer in the manner shown in Fig. 7 the employment of a separate auto-transformer can

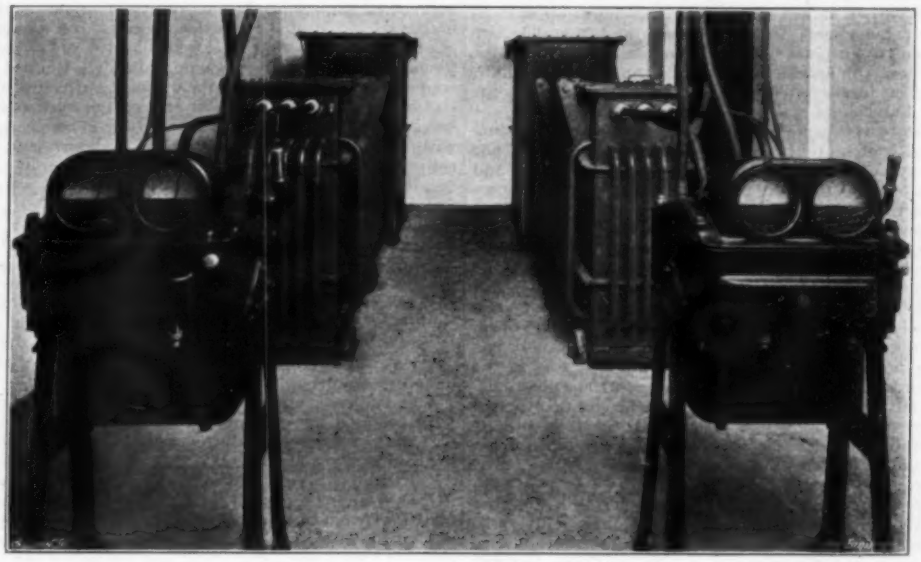


FIG. 9—CONDENSERS INSTALLED IN A WORKS

be avoided. Moreover, the extension of the secondary winding need only have sufficient section to carry the condenser current. The overwinding of a new transformer in accordance with this system is not by any means an expensive matter. If an overwound transformer with a condenser connected across its highest pressure terminal works in parallel with other transformers the condenser will have an influence on the power factor of all the transformers. Thus, if it should be necessary to add to, say, two 500 kVA transformers working in parallel in a sub-station an additional 500 kVA transformer and, say, a 300 kVA condenser, the new transformer could be overwound for the condenser when no alteration would be necessary to the existing transformers.

Examples of the application of static transformers made by the Telegraph Condenser Company for power factor correction are shown in Figs. 8 and 9. In Fig. 8 a pole type condenser is shown directly connected across the secondary winding of a step-down pole type transformer, thus improving the power factor of the system and increasing the available capacity of the transformer, whilst Fig. 9 shows two condenser equipments installed in a large industrial works in London, working on a two-phase three-wire 220-volt, 50-cycle supply. The complete equipment consists of four condensers with a total capacity of 774 kVA, each of the equipments shown in Fig. 9 having a capacity of 176 kVA. The condensers are housed in buildings adjoining two sub-stations and the condensers are directly connected to the 220-volt bus-bars. Each condenser equipment is designed to raise the power factor of the sub-station from 0·5 to 0·95, the total kVA reduction being 521. As the consumer is charged £5 per kVA per annum the total annual saving amounts to no less than £2600. Fig. 10 shows a condenser connected across an individual motor.

(To be continued.)

FEW are aware in relation to the Cornish Riviera Express being worked to Plymouth by one engine of the fact that the severe gradients, in particular those of the Dainton and Rattery inclines, on the South Devon line between Totnes and Plympton, are due to Brunel, when he laid out the line, having the intention to work it on the atmospheric principle. Under that method of operation, steeper gradients were practicable than those negotiated by locomotives. Hence there are on the length mentioned, stretches of 1 in 38, 1 in 41 and other severe climbs, and the working of the line has been handicapped accordingly. Brunel found, too, that he could provide sharper curves, and because there were no locomotives a 50 lb. rail could be used instead of rails weighing 70 lb. per yard, as on the Great Western. The objections to the atmospheric system were the difficulties in dealing with level crossings, that junctions and sidings could only be provided at stations where the train stopped, and the delays at stations whilst the vacuum was created. Actually, in the end the atmospheric system did not reach that portion of the South Devon Railway. The section from Exeter to Teignmouth was opened on May 29th, 1846, and thence to Newton Abbot on December 30th following. These sections were worked on the atmospheric principle, but it was used no further, and in September, 1848, locomotive power was adopted.

The Institute of Metals.

No. I.

THE autumn meeting of the Institute of Metals was opened at Derby on Tuesday, September 6th, with a lecture by Dr. Leslie Aitchison on "Non-ferrous Metals in Modern Transport."

Dr. Aitchison said that modern transport was a wonderful and a rather terrible thing, which excited sometimes our admiration and sometimes our extreme detestation. It always called forth our enthusiastic admiration, however, when we pondered upon it as an achievement in engineering, and metallurgists could take a particular pride in that achievement, for without the advances in metallurgy, transport might still be in the era of the stage coach and the four-masted brig.

As to the particular part played in the advancing science of motion by non-ferrous metals, it was not always easy to adjudicate between the ferrous and non-ferrous metals, because their functions were sometimes inextricably interwoven, and it was for that reason that, in that lecture, he had decided to review the situation generally, and to consider those particular properties of non-ferrous metals which made their use instead of iron or steel economically wise.

All metals possessed the following seven attributes, elastic modulus, melting point, magnetic properties, thermal conductivity, electrical conductivity, specific gravity and corrodibility, and it was in the extent to which this or that non-ferrous metal departed from the ferrous standard in one or other of those properties which provided the measure of its usefulness to the engineer. In addition, however, to the extent to which the deficiencies of the ferrous metals provided a scope for the employment of non-ferrous metals, the latter also had certain properties of their own. For instance, much more complicated pressings and stampings could be made in brass than in steel, and the spinning of soft non-ferrous metals was possible, whereas it was impossible with iron or steel. Again, die casting and hot pressing were to all intents and purposes impossible with iron and steel.

Dr. Aitchison then considered some of the particular reasons which have led to the adoption of this or that non-ferrous metal in the various transport systems of to-day. Non-ferrous metals, he said, did not bulk very largely in the principal structural members of various vehicles, and their use was to be found rather in delicate details of the structure and prime mover. In the group of metals headed by copper he mentioned condenser tubes. The great majority of condenser tubes to-day were made of 70/30 or 70/29/1 brass, but in America tubes made of 60/40 brass were frequently met with, though in decreasing numbers.

There was a certain number of people who held the opinion that it would be possible to produce condenser tubes in other alloys than those mentioned and so obtain a higher resistance to corrosion and, therefore, a longer life. The resistance to corrosion and the endurance provided by tubes made in 70/30 or 70/29/1 brass was very good, but by no means perfect, and an improvement would be welcomed by the users of tubes. The hopes of most of these people were centred upon the alloys of copper and nickel, and many trials were being made with a variety of such alloys. Those experimental alloys fell into two groups—at the copper rich and the nickel rich ends of the series respectively. The cupro nickels—occurring at the copper end—were fairly definitely standardised alloys, and condenser tubes were being tried in all of them, particularly the 80/20 and the 70/30 alloys. The other end of the system was represented by the Monel metal group, containing about 70 per cent. of nickel. In general work the resistance to corrosion increased with the nickel content of the material, and the Monel metal group gave better results than the materials known as cupro-nickel. It was also pretty definitely established that the general service resistance to corrosion possessed by Monel metal was greater than that possessed by ordinary brass. It was not established, however, that any of those alloys were able to endure the peculiar conditions that obtained in condensers better than the ordinary brass tube. Extensive trials were being made upon those alternative metals, but the fight for supremacy would last for a long time.

Condenser tubes in pure nickel were also being subjected to experimental trials. From a knowledge of the corrosion-resisting properties of that metal in ordinary service it might be safe to predict that condenser tubes made of it would give satisfactory results. As with the cupro-nickels, however, the available evidence went to show that prolonged full-scale work would be required in order to settle the question of their endurance. At present it was altogether too early to dogmatise respecting the composition of the condenser tube of the future, though a good guess might be made that the brass tube was not likely to be displaced from land installations. The thermal conductivity of the nickel-bearing tubes was lower than that of brass, and that was a disadvantage in condenser work. If the endurance and life were very much greater than that of brass tubes it might be possible to counteract the lower conductivity by reducing the wall thickness of the tube, but to do so would only be justified by a very markedly superior resistance to corrosion. At present it could not be said that the manufacture of tubes in pure nickel had been brought to the same stage of technical perfection as that of, say, 70/30 brass. The difficulties, however, were in a fair way to be overcome, and it was probable that the production of nickel tubes would be simpler than that of tubes of, for example, Monel metal.

In regard to locomotive boiler tubes the non-ferrous metal had to compete very strongly with steel, that competition being based purely on the question of first cost. Whilst, however, there was a certain amount of controversy as to the relative merits of copper and steel boiler tubes, there was practically none at all respecting the superiority of copper as the material for fire-boxes of locomotives. A similar grade of copper to that used for boiler tubes was used for fire-box plates and stays, and although the use of copper stay bolts was by no means free from difficulties, no really satisfactory alternative had so far been put forward. The problems arising in connection with stay bolts and particularly with those made in copper were receiving a good deal of attention at the hands of the British Non-ferrous Metals Research Association at the present time.

The conspicuously high electrical conductivity of copper was the physical property that accounted for its employment and naturally led to an extensive use of it in those branches of transport which relied upon electricity. In that particular field the ferrous metals could not possibly compete, the conductivity of all of them being hopelessly inferior to that of copper. Thus in generating plant and cables large quantities of copper were employed.

Copper tubes found an extensive use also in transport systems because of two valuable properties: first, the capacity to endure conditions that entailed heating and cooling; and second, their softness, which made for ease in bending and general fitting. To the former property the copper owed many of its uses in locomotives and the engines of steamships, and to the latter its extensive employment for steam pipes in steam engine practice, and for petrol and oil pipes in motor and aero-engine installations. One interesting employment of copper, though not a modern development, was that of sheathing the roofs of rail coaches. Such roofs withstood a very long service quite satisfactorily.

Various alloys of copper were typical of those non-ferrous metals that possessed a useful measure of strength and could also be cast with reasonable success. For the mechanisms of transport many parts could only be produced with due economy in the cast form, and they were generally made in one or other of the copper alloys. Resistance to the mild corrosive effect of the British climate and to the severe effect of the seven seas was often required, and many alloys of copper possessed a fair measure of that property. A conspicuous example was to be seen in phosphor-bronze propellers for steamships—an alloy which was probably the most resistant to sea water of all the ordinary alloys of copper. A further example was found in the lavish use of gun-metal castings in the construction of all seafaring ships.

In the next group—aluminium and magnesium and their alloys—the non-ferrous metals were able to offer a superiority over the ferrous which had not yet been developed to its full extent, and consequently it was possible to surround it with a little of the glamour of novelty. The property in question was that of a low specific gravity. In general terms, the aluminium group had specific gravities approximately one-third that of iron and steel, whilst the specific gravities of the materials based on magnesium were round about a quarter. Such low values were attractive in themselves, but were not likely to be of supreme importance to the engineer in the case of materials which had to withstand stresses of any magnitude, unless the same materials possessed also a useful measure of strength. An alloy of specific gravity 3 and a maximum stress of 5 tons per square inch was not likely to be more useful in saving weight than another material with a specific gravity of 9 and a maximum stress of 25 tons per square inch. In order that the light alloys should be of value in competing directly on a strength/weight basis with iron and steel they must possess a strength of about 4 tons per square inch where they were in competition with cast iron, and at least 10 tons per square inch for competing with mild steel. If the competition were to be with steels of greater strength the maximum stress of the light alloy must rise in proportion. These guiding figures applied to the alloys derived from aluminium. Those based on magnesium were competitive at rather lower tensile figures.

Discussing the cast aluminium alloys as a whole, Dr. Aitchison said that pure aluminium, of course, was not used in those circumstances that called for strength, but there were instances in which even its low ratio of strength to weight was adequate. Where a high ratio of strength to weight was required in a wrought form duralumin was invariably employed, and to a considerable extent the most interesting developments of weight saving in transport revolved around the application of that material. Seafaring vessels represented, of course, the heaviest type of transport, and up to the present but little field had been found for aluminium and its alloys in liners and steamships. On the other hand, in the construction of fighting ships the employment of the light metals was being developed very notably, for it was obvious that if those materials permitted the dead structure weight—using structure in its very widest sense—to be reduced, a greater margin of weight could be applied to the needs of armaments, offensive and defensive. So far it was very doubtful, however, whether sufficient advance had been achieved to produce such a convincing demonstration of the virtues of weight saving as would cause the mercantile marine to adopt light alloys extensively in order to increase the carrying capacity of its ships.

In railway transport two sections of the transporting systems had to be considered, *e.g.*, the hauling unit and the vehicle that was hauled. Up to the present the locomotive, whether steam or electrical, had kept itself pretty well free from light metals, but amongst the hauled parts a good deal was being done, and more would be done, to reduce weight. A very good instance of the successful replacement of steel by a light alloy was provided by the construction of passenger coaches. A very fairly standardised method of construction of such vehicles in recent times had consisted of a framework of steel built up on steel longitudinals, which in turn were secured to the bogies. The framework consisted of steel angles and channels, and a veritable host of pressings, together with some sections that approached towards standard forms. The outer casing and the roof of the car were composed of steel plates riveted to the frame. Nearly all those items could be made in light alloys. The standard sections could be extruded and the pressings could be formed from sheets, whilst such castings as were used presented no difficulty. Similarly, duralumin plates could replace the steel sheets for the casing of the vehicle. A set of coaches recently built by the Pennsylvania Railroad Company in America showed a reduction in weight of 5 tons per coach, the light alloy being applied solely to the superstructure.

On other types of passenger coach, notably the type with doors only at the ends, the panelling of the exterior of the coaches offered an opportunity—which was not being neglected—for the adoption of light metals. Aluminium sheets were scarcely sufficiently robust for that type of work, being too liable to denting and distortion, but duralumin sheets provided a perfectly adequate substitute for steel sheets. Aluminium alloy castings were used for the mechanically operated sliding doors of the passenger coaches of the underground electric railways. Each of those doors was cast in one piece in an aluminium silicon alloy and were very serviceable and convenient. The same alloys, and others, were employed for window frames in rail coaches.

Containers used by manufacturers for the conveyance of packed goods were lighter, when made in light alloys, than those made of steel or of wood supported on a steel framework, or of wood entirely, and were a great deal more durable than any of those containing timber. Extruded sections and rolled sheets provided the bulk of the material employed for the light alloy construction.

Road transport provided great opportunities for weight saving. In all classes the desire to create as great a margin as possible between the total economic hauling capacity of the vehicle and the deadweight of the structure obtained. The millions of gallons of petrol consumed unnecessarily in transporting dead structural weight in commercial vehicles was simply appalling; by reducing the total weight of a laden vehicle petrol consumption might be reduced and lower-powered engines employed, with some saving in tax. It was fairly evident that the wear and tear on our highways was becoming such a severe problem that legislation in the direction of limiting axle weights would become more severe rather than less and would lead to a still further reduction of structural weight. It was only by reducing the tare weight of the vehicle that a reduction of the axle weights could be economically achieved.

In addition to reducing the weight of the structure of a vehicle, however, it was possible to save a good deal of weight in the power unit and its auxiliary parts. The use of light alloys in certain parts of the engine resulted merely in a saving in the gross weight of the vehicle, but their employment in other parts resulted in the efficiency of the engine being greatly improved. In the automobile engine at the present time it was quite usual to employ pistons made in one or other of the recognised casting alloys. The particular one chosen, apparently, depended more upon the virtues of salesmanship than upon any particular technical virtue. Allied with the use of the aluminium alloy piston came the use of the duralumin connecting-rod. That practice was fairly universal, almost the only exception being found in those engines that employed a high-tensile steel rod machined all over to very fine dimensions. Each of those parts was reciprocating mass within the engine, and a reduction in their weight produced a reduction in the loads on the big end bearings, with a consequent gain in life. Incidentally, the reduction of weight in those reciprocating masses spelt a reduction in inertia, which in turn brought an increased ease of acceleration—one of the most prized attributes of the modern car.

Although magnesium pistons were not much in evidence in this country, they were being used in Germany to an appreciable extent in certain types of car. The favoured alloy at present was the magnesium-aluminium-silicon alloy rather than the magnesium-copper alloy previously used.

Other parts of the engine and auxiliaries in which light alloys were used were generally made as castings, those being cylinder heads, crank cases and sumps, gear-boxes and gear-box covers. In addition, differential covers, carburetter bodies, fans and the like were very generally made of aluminium alloys. As with the pistons, some German makers employed magnesium to some extent for such castings.

In motor omnibus construction the application of wrought light alloys had probably gone further than in lorries or private cars. In some omnibuses the whole of the superstructure was being constructed of the light alloy, which led to a big saving in weight. Change-speed levers, brake levers, luggage grids and bumpers were common enough in wrought light alloys, while panels in duralumin or aluminium were widely employed. It seemed likely, however, that one of the greatest eventual savings would be found in the use of duralumin for road wheels. That was a big field which had not yet been fully explored, but it was full of promise. Cast aluminium wheels had been used with some success and the forged wheel would undoubtedly go further.

Dealing with tramcars, Dr. Aitchison said that in America aluminium castings and duralumin sheet and sections had been adopted very widely in some systems to replace steel, and a resulting saving of over 30 per cent. in weight had been obtained. That example did not appear to have been followed in this country yet, but was being adopted in Germany.

The most fascinating application of light metals occurred in aircraft. In the air lightness was naturally at a premium, but it must obviously be allied with strength. For structural purposes in aircraft the non-ferrous metals had to compete with, on the one hand, steels of various types and strengths, and on the other with timber, a material with very remarkable properties. Whereas it might be possible to design a lighter structure in high-tensile steel than in a light alloy, the use of the latter was frequently preferred, inasmuch as the additional volume of metal was of the greatest convenience to the constructor, because it produced rigidity and conferred ease in handling.

With regard to the lighter-than-air craft, as represented by the dirigible rigid airship, he said that that rather exotic form of transport had been the exclusive sphere of duralumin construction. Whether in the future that metal would have to share a part of the honour with steel depended a good deal on the performances of the two British ships at present being constructed. The Zeppelins were built up from a variety of rolled and drawn sections, the thickness of the metal varying from about fifteen-thousandths of an inch to perhaps one-eighth. The sections were built into girders, which were then joined together to form the approximately circular transverse frames of the ship. From similar units the longitudinal girders were formed, the joints between the longitudinal and transverse girders being formed from pressings joined together by duralumin rivets. The whole structure was finally tied together by steel piano wire. The dirigible airship was a masterpiece of skilful engineering design, but it was extremely doubtful whether the construction would ever have been worth attempting if a strong wrought light alloy had not been available. It seemed fairly safe to say that a dirigible entirely composed of steel would be impossible to construct, even though it might be feasible to create a paper design for such a vehicle. It was likely that the rigid airship would always remain a predominantly non-ferrous structure, though there might be some dilution of the light alloys with high-tensile steel. It was possible also that magnesium alloys would replace duralumin in the less highly stressed portion of the ship.

The design of heavier-than-air craft was in a process of transition, several rival types of machine being in process of development. The first type was nominally all steel, the second nominally all duralumin, the third consisted of a mixture of steel and duralumin, whilst a fourth contained some timber. Whichever of these types eventually emerged as the accepted standard, it was tolerably safe to predict that the successful type would embody a very fair proportion of light alloy.

Indicating those portions of the heavier-than-air craft now being constructed largely, and in many instances entirely, of light alloys, he said that wing and tail spars were made from rolled and drawn sections, whilst longerons, interplane struts and the like, were either made of similar materials or of solid drawn tubes. Ribs were almost always made from light alloys, being either stamped and flanged from sheet or riveted up from solid drawn tube or drawn channels. In modern all-metal design, it was considered desirable that the skin of the machine should perform a useful structural function, and should carry some share of the stresses existing in the aeroplane itself—a *rôle* which could not be played by fabric. A metallic substitute for doped fabric was urgently desired during the war, to reduce fire risk, but unfortunately the available materials were too heavy—piece for piece—and the only successful application of metal was achieved when the wing covering was adopted as a definite structural unit, thus securing some compensating reduction in the weight of the other structural members. Nowadays duralumin wing coverings were relatively common, though there was a doubt whether that form of construction had yet been brought to the same stage of perfection as that embodying doped fabric. Metallic wing covering provided yet another instance in which the aircraft engineer would undoubtedly have been quite powerless in the absence of the light non-ferrous alloys.

A conspicuous development in seaplanes was the displacement of the wooden by the all-metal float, a spectacular example of the success of such floats being the duralumin floats built by Messrs. Short Brothers, for the machine flown by Sir Alan Cobham on his trip to Australia and back. Equally striking was the construction of the hulls of flying boats entirely of metal. A perfectly water-tight hull was produced, and the use of metal eliminated entirely that bugbear of wooden hulls—the very large and variable absorption of water. At one time the petrol and water tanks were always made of tinned steel, but now they were frequently made of aluminium or a light alloy. For many years the propeller was always made of wood; then a certain proportion was made in steel; and now a very notable number were made in duralumin to a variety of designs.

By reason of the thinness of the components, the light alloy casting had little opportunity of useful service in the structure of aircraft, though there was an increase in the use of die castings—particularly of the aluminium-silicon alloys—for the less heavily loaded fittings and joints. In the engine, however, the aluminium alloy casting played a much bigger and important part. In a typical engine light alloy castings were found in such parts as the crank case, the cylinder heads, the water jackets of the cylinders in water-cooled engines, the water pump casing, the piston, the carburetter body, the oil pump body and a considerable number of other auxiliary parts. In the modern aero-engine wrought light alloys in the drop-forged state had taken the place of castings for pistons, with improved results, owing to their considerably higher strength at the high working temperatures maintained in such parts. In at least one engine also a duralumin drop forging had replaced the cast crank case, and had resulted in a marked saving in weight, not simply in that one particular unit of the engine, but in many others that hinged upon it. In addition, at least one aero-engine was using drop-forged, light alloy connecting-rods with complete success.

In modern transport nickel and its alloys were not so largely used as copper or aluminium. Apart from the probable development of pure nickel tubes for condensers, there was little use of the pure metal. But the pronounced capacity of nickel for resisting corrosion was not entirely lost upon the transport industry, and a good deal of nickel-silver was used—an alloy which, particularly in its better grades, was able to resist corrosion very successfully. The alloy was employed a good deal for such purposes as the cowls of automobile radiators. It could be pressed into shape with comparative ease, and after polishing was very satisfactory, being, of course, vastly superior to nickel plated articles in at least one respect, namely, that it was not liable to look patchy as a result of regular cleaning. Nickel-silver castings were employed for a variety of ornamental parts in different forms of vehicles, and it was almost solely on account of their resistance to corrosion that the alloys of nickel were employed at all.

Besides copper, nickel and aluminium, there were a good many other non-ferrous metals and the alloys thereof, but not many were used to an extent that would warrant much discussion. The most important of those other metals were found amongst the anti-friction metals, that being a detail of engineering design in which the non-ferrous alloys were supreme, the use of iron or steel for plain bearings being quite unheard of. The most suitable alloy or metal to use for a bearing depended entirely upon the conditions and the nature of the service expected. Probably the most severe conditions were those obtaining in the big end of the master connecting-rod in a high-powered multi-cylindered radial internal combustion engine. In such a service the loading was very high, and only the most excellent anti-friction metals would endure. For those bearings it was the invariable rule to employ alloys very rich in tin. Such alloys fell into two broad groups, the tin content of one group being about 80 and of the other about 90 per cent., and in each the balance was antimony and copper.

Bearing metals composed entirely of lead did not find very much favour in the various transport machines. They were mostly soft, and were not well fitted to the service expected. Bearings not suited by the high-tin anti-friction metals were usually made of either phosphor bronze or gun-metal, the former being regarded generally as superior to the latter, though more expensive to produce. Phosphor bronze was used in both the cast and the wrought condition. Generally, it was used as cast, though it was not by any means an easy metal to produce in the sound condition that should exist in bearings. Probably if phosphor bronze castings could be produced with the same certainty as, say, brass castings, they would be used still more, and would displace gun-metal bearings to a greater extent. It was with the intention of avoiding the difficulties encountered in phosphor bronze castings that the wrought alloys—usually drawn tubes—got their chance. Gun-metal was used a great deal in connection with the auxiliary parts of bearings and in valves and steam regulator slides.

The lead bronzes were rather various in composition, as shown by the following table:—

Copper, per cent.	..	80	..	65	..	72	..	83
Tin, per cent.	..	5	..	5	..	2	..	11
Lead, per cent.	..	15	..	30	..	7	..	2
Zinc, per cent.	..	—	..	—	..	19	..	4

Bearings in lead bronze were of signal service in heavy road vehicles, and were used extensively in locomotives. They were not at all easy to produce with perfect satisfaction, but possessed a number of advantages.

In conclusion, Dr. Aitchison said that although in such a lecture, a great deal had of necessity to be omitted, enough had been said to show that the physical properties scheduled at the beginning were sufficient to account for the preferential employment of the more expensive non-ferrous metals. To select one property as being more important than another in determining that preference was quite impossible. With such a large subject to examine, it was inevitable that some rather sweeping statements must be made, and the broad lines rather than the finer shades of opinion be stated. If some of the expressed opinions appeared to be too unqualified, the explanation was to be found mostly in that fact, and it must be acknowledged that there were some exceptions to nearly every rule.

B.E.S.A. Specifications.

STREET LIGHTING.

THE British Engineering Standards Association has just issued a specification which provides a basis upon which street lighting installations can be compared, tenders invited, and installations tested, on an equitable basis. It furthermore specifies the technical conditions applying to the maintenance and testing of street lighting installations under service or working conditions.

The local statutory authority, the supply undertaking, the designer of the installation, and the manufacturer are interested in a street lighting specification in different ways, which are liable to vary in different localities, and it has not been possible to sectionalise the clauses of the specification to suit all conditions; it has been left to the parties concerned to adopt such clauses as meet the needs of possible contracts.

The importance to the public of well-lighted streets cannot be overestimated, and it is the opinion of many competent observers that the present standard and quality of illumination in many artificially-lighted streets should not be accepted as good British standard practice. It was, therefore, felt that a British Standard Specification for Street Lighting should deliberately set a standard of street lighting which was higher than that commonly existing at the present time. For this reason it was decided to omit altogether from the categories of the specification a type of lighting—sometimes spoken of as "beacon" lighting—in which lamps are placed at such wide intervals that they indicate the edge of the road rather than illuminate the highway or the vehicles and pedestrians using it. There is no doubt in the minds of those responsible for this specification that during the next few years the trend will, and should be, towards higher and better distributed street illumination, and the standards have been set to anticipate the immediate future rather than to stereotype the past.

Street lighting installations are divided into eight classes, the last of which, Class H, is not recommended for streets which are likely to be used appreciably for through traffic. A minimum height of the light source above the ground and a maximum spacing-height ratio are specified.

The question of glare has received a good deal of attention by the Committee, and whilst it is recognised that until a much more fundamental investigation has been made of this subject—such investigation is at present being carried out by the Department of Scientific and Industrial Research for this Committee—nothing very definite can be specified, a method for estimating the approximate amount of glare from a given installation has been devised and put to some practical tests, and is included as an appendix to the specification.

Prior to its issue, the specification was given a very wide circulation, over 1000 copies having been distributed to the various Institutions and Associations interested and their comments invited. It was also discussed before the Institution of Electrical Engineers, the Council of the Institution of Gas Engineers, the Illuminating Engineering Society, and a paper on it is to be presented at the forthcoming annual meeting of the Institution of Public Lighting Engineers. In principle, the specification was favourably received and has awakened a wide interest. The comments received were too numerous to answer individually, but they were all most carefully considered, and radical changes were made in some of the clauses as the result of the criticisms received.

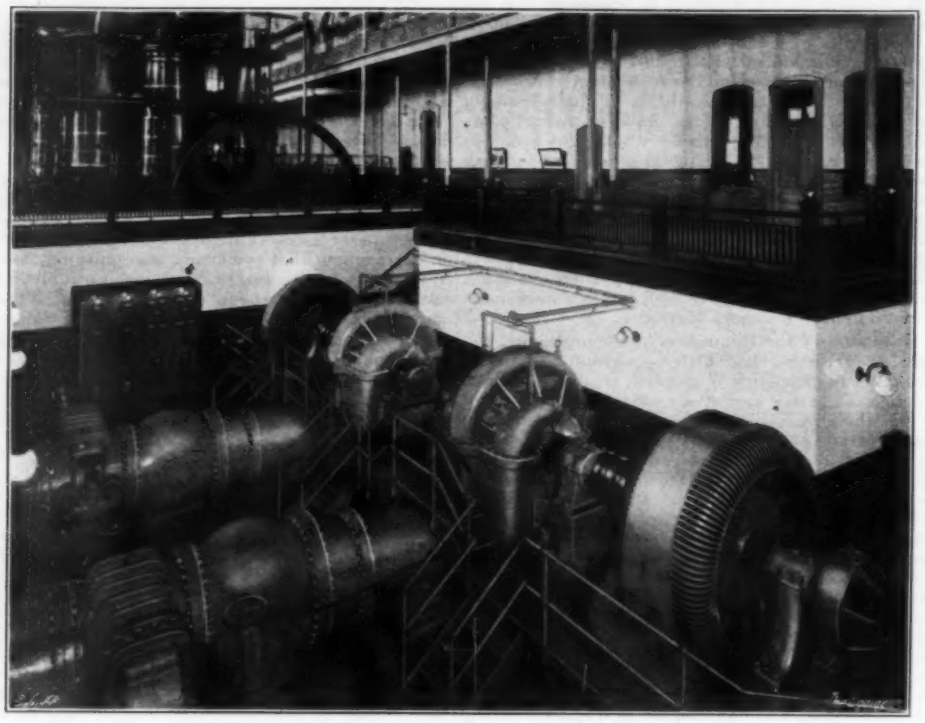
It is not anticipated that this is the final word on the subject; the British Standard Specifications are reviewed periodically, and it is hoped that as this specification is put into use proposals for its improvement may be sent in to the secretary.

The attention of those who received copies of the first printed proof of the specification for comment is called to the fact that the published specification contains many important changes. The published edition can be obtained from the B.E.S.A. Publications Department, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

IN the summary of the official report on the failure of the banks of the Mississippi River, it is stated that the levee crown is supposed to be well above the line of saturation, with a flood 3ft. below the levee grade. With the water at or above levee grade, the crown is subject to complete saturation, and, under these conditions, makes a poor foundation for added topping.

ELECTRICALLY-DRIVEN CENTRIFUGAL PUMPS

THE WORTHINGTON PUMP AND MACHINERY CORPORATION, NEW YORK, ENGINEERS



High Efficiency Centrifugal Pumps.

IN the following article particulars are given of two large centrifugal pumps, which have reached the high efficiencies of 86 and 88·5 per cent. But possibly the most interesting fact in connection with them is that two models were made to investigate the properties of the full-size pumps. These models not only showed that certain modifications in the designs were necessary, but enabled the makers to predict with considerable accuracy the efficiency and horse-power characteristics which might be expected of the pumps in service.

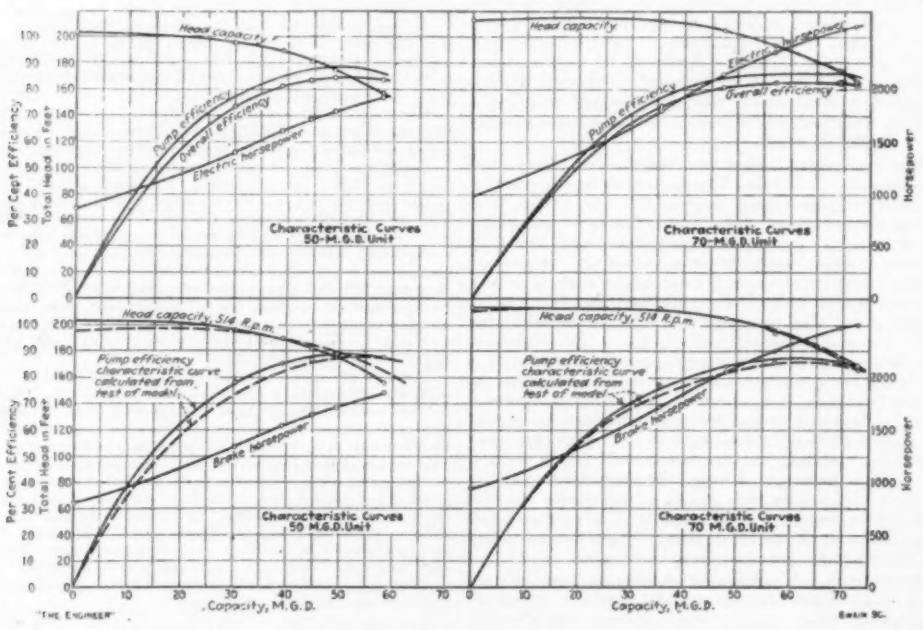
IN a recent issue we made brief reference to the remarkably high efficiency of some electrically driven centrifugal pumps in the station of the Detroit Board of Water Commissioners, and now, through the courtesy of the *Engineering News-Record*, of New York, we are able to give some more detailed particulars of the pumps and of the tests to which they were subjected. In making the following extracts from an article by Mr. W. Schwanhausser, of the Worthington Pump and Machinery Corporation, the makers of the pumps, we have added to the American units their British equivalents.

As will be seen from the engraving which we reproduce, there are two pumping sets. One of them has a capacity of 70 million gallons (58,310,000 Imperial gallons) per twenty-four hours, while the other delivers 50 million gallons (41,650,000 Imperial gallons) a day. They both work against a head of 170ft. Although the pumps have this difference in output, it was stipulated by the purchasers that their casings should be similar, so that the capacity of the smaller pump could be brought up to that of the larger unit by changing the impeller only. In spite of this fact, an overall efficiency of the pump and motor of 80 per cent. was demanded. A bonus for any higher efficiency up to 85 per cent. was offered, with a penalty for lower efficiencies and an option for rejection if the efficiency did not exceed 78 per cent. Added to the difficulties which these conditions imposed upon the designers, they were urged to deliver the pumps in a very short time, as the city was short of water.

In the circumstances, it was decided to make two small-scale models concurrently with the preparation of the detailed designs for the full-sized pumps, and to test these models under "similar" hydraulic conditions, so that any necessary alterations could be made before the big sets were too far advanced. For the model experiments two casings differing slightly one from the other, and two impellers also differing slightly, were constructed and tested. From the results of the tests two conclusions were drawn. The first of these involved the modification of the details of the full-sized pump, the main parts of which had been progressing through the shop in the meantime to meet time limits. The other conclusion was a prediction of the efficiency and horse-power characteristics of the full-sized pumps to be expected in the field.

In this way it was planned to secure the highest possible efficiency; the minimum time of production of a wholly new design, including its erection; and it was also expected that with model data available the pump when installed would not only perform as predicted, but that it could be kept in service as was desired by the city.

The main units were tested in January, 1927, by Mr. William C. Rudd, Assistant Engineer of Power, Detroit Department of Water Supply. The results of these tests are shown in the graphs which we reproduce, but it should be borne in mind that the quantities there given are in U.S.A. gallons, which should be multiplied by 0·833 to convert them into British gallons. From these curves it will be seen that the larger set, when delivering against a head of 173·89ft., had an overall efficiency of 82·8 per cent., and of 86 per cent. for the pump alone. The smaller unit, working against a head of 174·29ft., had efficiencies of 84·7 per cent. overall and 88·5 per cent. for the pump alone.



CHARACTERISTIC TEST CURVES

The direct value of the model construction and test procedure, which obviated the necessity for any shop tests of the main units, except hydrostatic and balancing tests, and permitted the attainment in the field of the desired results, is shown by comparing the characteristic curves of the model pump and the curves of the full-sized units obtained during the official test given in the two lower diagrams. These curves show that the performance of the 70-m.g.d. unit is practically coincident with the performance computed from the model. While the performance of the 50-m.g.d. unit departs somewhat from the model, the divergence was not unexpected under the circumstances, and falls within the capacity of the designer to predict.

The motors which drive these pumps were supplied by the General Electric Company and are of 2600 horse-power and 2050 horse-power respectively. They are of the synchronous type, with direct-connected exciters, and run at 514 r.p.m.

In a supplementary article by Mr. W. C. Rudd, in our contemporary, the following particulars of the equipment of the station are set forth:—

The priming pipes of the main pumps are connected with the suction chambers, and are piped to an overhead closed vacuum tank. From this tank a pipe is brought down to two vacuum pumps, which are of the Nash rotary type, and are driven by 220-volt, three-phase, 60-cycle, 5 H.P. motors.

One of the vacuum pumps is started and stopped by an automatic vacuum switch, but either of them may be started manually, in case the vacuum switch fails to operate. By means of this system, both main pumps are kept automatically primed at all times. This is especially important in view of the fact that in case one pump is running and suddenly fails to operate, the other pump can be started quickly, since it is primed and ready for operation.

The motors are of the remote-control hand-start type, with motor-operated switching equipment arranged in a switch house near the pit in which the pumps are installed. In order to start one of these large pumping units all that is necessary is to pull a small button-type switch on the switchboard in the pump pit. The control switchboard in the pit has no higher voltage than 220. The high-tension wiring enclosed in the switch house works at 2300 volts.

The power feeders for these two pumping units are three in number, so arranged that each pump has duplicate power feeders. Furthermore, these feeders are so arranged that the service can be secured from either one of two large electric power transformers. The power service is furnished by the Detroit Edison Company at 24,000 volts and is transformed to 2400 volts by means of two 7000-kVA transformers. These transformers are connected up on the low-tension side through a double-bus system, so that either transformer can be used independently of the other.

There is also installed in the pit with the two large pumping units, a motor-driven air-wash type of fan to force air up under the motors, air being brought in from the outside or the inside of the pump house. The capacity of this fan is 14,000 cubic feet per minute.

Another feature of this installation is the fact that the auxiliary power service for operation of the vacuum pumps, the fan and the sump pump is taken from the high-tension power lines to the main pump motors and transformed to 220 volts. The transformer for this purpose is arranged in the building that houses the high-tension switching equipment. This transformer is intended to be used for duplicate power service.

In the switch house there is also another transformer to transform current from 2300 to 110 volts for use in the lighting system for the pump pit. This overhead lighting system is one of the interesting features of the installation. There are nine 1000-watt lamps fixed about 65ft. above the pumps. These lamps give a very satisfactory light for night-time operation.

LAUNCHES AND TRIAL TRIPS.

TEAKWOOD, oil tank steamer; built by Sir W. G. Armstrong, Whitworth and Co., Ltd., to the order of the Teakwood Steamship Company (1926), Ltd.; dimensions, 430ft. by 54ft. 6in.; 8825 deadweight. Engines, direct-acting, triple-expansion, surface-condensing; pressure, 180 lb.; constructed by the builders; trial trip, August 15th.

BRIXTON, collier; built by S. P. Austin and Son, Ltd., to the order of the South Metropolitan Gas Company, Ltd.; dimensions, 244ft. by 36ft. by 20ft. 6in.; 2440 tons deadweight. Engines, 18in., 30in., and 49in. by 30in. stroke; pressure, 180 lb.; constructed by the North-Eastern Marine Engineering Company, Ltd.; trial trip, August 16th.

GRANTLEY HALL, steam cargo vessel; built by Harland and Wolff, Ltd., to the order of the West Hartlepool Steam Navigation Company, Ltd.; dimensions, 427ft. by 55ft. 8in. by 38ft. 3in. 4760 gross tonnage; trial trip, August 16th.

CITY OF WORCESTER, cargo steamer; built by Earle's Shipbuilding and Engineering Company, Ltd., to the order of the Ellerman Lines, Ltd.; dimensions, 413ft. by 53ft. 6in. by 31ft. 4in.; 8900 tons deadweight. Engines, triple-expansion, 23½in., 40½in., 70in. by 48in. stroke; pressure, 220 lb.; constructed by the builders; launch, August 18th.

RAMILLIES, steamer; built by William Gray and Co., Ltd., to the order of Mr. John Cory, of Cardiff; dimensions, 412ft. 6in. by 53ft. by 35ft. 1½in. Engines, triple-expansion, 26in., 42in., 70in., by 48in. stroke; pressure, 180 lb.; constructed by the builders; trial trip, August 25th.

BRIGIDA, oil tanker; built by Harland and Wolff, Ltd., to the order of the Anglo-Saxon Petroleum Company, Ltd.; dimensions, 305ft. by 50ft. by 15ft.; 2700 gross tonnage. Engines, two sets of triple-expansion, 13½in., 23½in., 36in. by 27in. stroke; pressure, 180 lb.; constructed by the builders; trial trip, August 30th.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

The Steel Rebate.

OPINION in Midland and Staffordshire engineering circles is divided as to the chances of success of the revived system of rebates to purchasers of British steel which came into operation on the 1st inst. It is recalled that the scheme established before the war was substantially the same as that now in operation. The number of associated firms is rather larger. So is the rebate offered —5s. per ton in respect of plates and sections, and 7s. 6d. to 12s. 6d. in respect of joists. But the essential principle is the same, and the old scheme only met with a certain measure of success. Those sponsoring the present scheme, of course, recognise that the rebates agreed upon will not bring the price down to the continental level, but it is thought that they will have sufficient effect, coupled with the added convenience of quick delivery and the cutting out of sea carriage, to stimulate the purchase of British steel to an extent sufficient to place the industry again on a sound footing. Users of steel know that in comparing home and foreign prices many considerations enter in to lessen the apparent disparity between them. The following quotations for continental steel consigned to Birmingham, *viâ* Antwerp, must be read with this in mind —Angles, £5 19s.; joists, £5 15s.; plates, ¼in. and over, £7 6s. 6d. Whether the rewards offered by producers to those of their customers who undertake to buy from them and them only are calculated to effect any considerable transfer of business is a matter on which the market is open to conviction. There is reason to believe that German producers of steel can and will lower their export prices to meet this move on the part of their competitors, and there can be no doubt but that many British steel consumers will buy, at the cheapest rate. Many of them use steel to produce goods that have to be sold in foreign markets, against severe competition. It seems doubtful if the scheme of rebates, as we now have it, will tempt them. Merchants on 'Change considered the terms of the offer opposed to their interests. Some Midland steel masters are ardent believers in the scheme. They cite pre-war experience and the experiment which has been in progress recently on the North-East Coast and at Barrow and Birkenhead. Other producers regard the rebate as a desperate effort on the part of the industry to help itself, and they do not profess any great optimism concerning the issue. The attitude of engineers and other big consumers is determined by their dependence on or independence of foreign steel. This scheme will be advantageous to some, but to others the rebate will be a very small offset to the surrender of their liberty to buy in the cheapest market. On one point there is general agreement —the British steel trade is in a very bad way and everything possible should be done to strengthen it against foreign aggression. In some quarters satisfaction is expressed that the rebate has not been further delayed, as it is believed that a good deal of work is to be placed in October and November. A number of constructional engineers have for some time declined to buy foreign steel, but it is considered doubtful whether heavy buyers of the latter will sacrifice their freedom to buy in the open market, especially as under the head of joists the full rebate will still give an advantage of £1 per ton to the buyers of foreign material. The British re-rollers have for some time been dropping their prices until the margin for small bars and various descriptions of strip has become decidedly narrow. They will be unaffected by the rebate, as they are not included among the steelmakers who devised this plan of meeting foreign competition. The basis rates for steel which have ruled hitherto still apply, the only difference being that consumers who are willing to bind themselves for not less than six months to buy British steel solely will get rebates. So far as business on 'Change in Birmingham to-day was concerned, the effect of the new movement was hardly noticeable. It is clear that a little time must elapse before the effect arising from the new position can be ascertained. Welsh makers of billets and steel bars have been quoting rather easier prices lately, although only small quantities find their way into the Birmingham district at present.

Pig Iron.

Midland smelters are making every effort to prevent any further price depreciation, and so far their endeavours have met with success. Moreover, the firmness of quotations has slightly stimulated buying. On 'Change in Birmingham to-day, though there was little buying in bulk, a fairly large number of small transactions for foundry sorts were put through. For the most part they appear to have been negotiated at £3 10s. for Northamptonshire and £3 5s. for Derbyshire. Some consumers claimed to be able to buy Northampton foundry at 6d. per ton below this figure, but confirmation was lacking. North Staffordshire iron, owing to an increase in the number of blast-furnaces in that district—there are now three in operation—is in more plentiful supply, and can be bought at £3 5s. Some pig iron consumers are still waiting for further price concessions, but others are of opinion that the new low levels will attract business, and that further reductions are unlikely. An encouraging feature is the comparatively low price asked for furnace fuel, coke being offered at the Yorkshire ovens at 12s. 6d. per ton. Ovenmen are, however, now getting a tighter grip of the market again, and are said to be limiting transactions at current rates. They look to the winter demand for central heating and other purposes unconnected with the iron trade to redress the balance between production and consumption and to give them the market initiative once more. Smelters know that productive capacity is much greater than the present rate of output and consider ovenmen are more likely to increase output at present rates than attempt to exact artificial prices by under-production. The anticipated autumn demand for pig iron is slow in materialising, but there are prospects of a steadily increasing demand, and stocks are so low at consumers' works that it is considered a certainty they must shortly come into the market for fresh supplies.

Finished Iron.

The Staffordshire finished trade does not improve. A fair inquiry is maintained for marked bars at £13 10s., but other grades sell very slowly. Crown bars have lost ground, many sellers now quoting them £10 5s. per ton, a reduction of 5s. on recent rates. Whether they have been influenced by the competition of Lancashire houses who have been seeking business in this district at round about £10 is problematical, for little business appears to have been given out to any one during the past month. It is too early to say whether the cut in prices will stimulate consumption, but judging from past experience no great accession of strength is expected to be given to demand. Nut and bolt and fencing iron of Staffordshire make continues to be quoted £9 15s. The bulk of this class of iron used in the Midland works is obtained from foreign sources on account of its much lower price. Black Country makers of iron fencing report a fairly good trade, but there has been a decline in the nut and bolt trade, attributed to the slackening on the part of engineering construction work. Now that the Institution of Gas Engineers has issued a specification requiring the British maker to accompany his invoice with a declaration that the iron is made from pure British puddled iron, ironmasters in Staffordshire foresee increasing demands from tube manufacturers. The specification, of course, excludes the use of scrap, but the maker does not complain, since it helps to maintain the reputation of Staffordshire material as the most efficient rust resister for the manufacture of tubes. It is believed that increasing quantities of tubes are now made from Staffordshire iron. Although the gas strip from which it is made costs about £3 per ton more than steel, it is believed that this is compensated for by the longer life of the tube under conditions in which a steel tube would probably be destroyed by rust. German tube strip is coming into the district in considerable quantities at prices below the local product. Improvements are being made, however, at tube works in the district, and local makers are determined to capture the tube trade in neutral markets. Some attention has been attracted in Midland circles by a statement, apparently well authenticated, that important tonnages of British butt-welded tubes have been sent from the Birmingham district into Germany at prices below those charged by the German manufacturer. The ability to do this is said to be due to the excessive price charged to the German user.

Sheet Values.

Though inquiry for galvanised sheets has fallen off somewhat this week, they are still in moderate request, overseas customers providing the bulk of the business. Values are maintained at last week's level, 24 gauge corrugateds being quoted £14 to £14 2s. 6d. An improvement in demand during the next months is confidently anticipated.

Scrap.

Little business in steel scrap is being put through, South Wales consumers demanding quotations of £2 17s. 6d., against the offers of sellers at £3 2s. 6d.

Engineering Trades.

Engineers in the Midlands and Staffordshire are engaged in weighing the prospects for the remainder of the year, and it would appear they are not generally satisfied with the result. Constructional engineers here and there have secured good orders, but in the main only small specifications are being given out. Firms specialising in boilers and tanks report a falling off in demand. A fair amount of business is coming through for aircraft metal work, petrol tanks and pumps and welded tanks, this line having maintained a steady level for the greater part of the year. Reports from the steel rolling mills indicate that a good standard of production is still being maintained.

Miners' Wages—Owners' Losses.

Cannock Chase and Pelsall miners' wages for September will, for the third consecutive month, be down to the minimum allowed under the 1926 agreement—42 per cent. on the basis. This means that the minimum wage of stallmen will be 9s. 4d. per shift, compared with 11s. 6d. in June and 11s. 2d. from February to May. The new wage for loaders will be 8s. 4d., and able-bodied adult surface workers 6s. 8d. September wages are based on the produce of the industry in May, June and July, and it is important to note that the earnings of the industry are actually only sufficient to pay 14·31 per cent. on the basis rate, or roughly 7s. 6d. a shift for stallmen, so that during September the owners will pay in wages 27·67 per cent. more than they can really afford. There is now an accumulated deficit in this area since the agreement was signed in December last of £248,000. In the Warwickshire coalfield the percentage addition to basic wages for September will be 51 per cent., as against 55 per cent. for August and 63 per cent. for July. In the case of the lower-paid men there will be, however, little actual reduction, as they are protected by the agreement for a subsistence wage.

Proposed Staffordshire Sugar Beet Factory.

I understand that a project is on foot for the establishment of a beet sugar factory in Staffordshire, and that a company is in process of formation to carry out the scheme. An option, it is stated, has been secured on a site at Penkridge, where it is intended to build a factory capable of dealing with 100,000 to 120,000 tons of beet per annum. Staffordshire farmers will be glad to avail themselves of the facilities this enterprise will afford for disposing of their sugar beet without heavy transport costs.

Unemployment.

Unemployment in the Midlands for the week ended August 29th affected 143,623 persons, 59,375 of whom were working on short time or who were off work only temporarily. The total is 3891 less than on August 22nd, when 147,514 persons were out of work. In the Birmingham area there are now 26,009 unemployed, as compared with 28,233 on August 22nd, and 25,795 on August 15th. At Coventry the number has increased from 7335 to 7349, while slight increases are also reported in Oldbury, Smethwick, Wednesbury, West Bromwich, and other Black Country areas.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

The Engineering Outlook.

CONSTRUCTIONAL engineering firms in the Lancashire district are still one of the two busiest branches of the engineering industry. A number of them are still actively engaged on contracts already on the books, and there are prospects of new business to follow these up. In the case of the machine tool section the position is not satisfactory and there is plenty of room for improvement. In a not much lesser degree the same may also be said with regard to the locomotive builders and the boiler-making industry, although in the former case recent contracts that have been received have livened things up a little. The position in respect to other branches of engineering is summed up by the Manchester Chamber of Commerce monthly record, in the course of a general survey of industrial conditions, as follows:—The heavy electrical trade continues to get large contracts, both for home municipalities and for export. Cable-makers are getting a decided benefit from the activity in the heavy electrical engineering trade, and motor manufacturers, having in several cases reorganised there business, are now well engaged. There is no visible change for the better, however, in other sections. Some textile machinists are well supplied with orders, but others could do with more.

Non-ferrous Metals.

In the tin section of the market for non-ferrous metals during the past week there has been only a moderate buying movement, and the most interesting feature has been the month-end estimates of visible supplies of the metal. These figures agree upon a further reduction, and consequently a further strengthening of the statistical outlook for the metal, but, as has been pointed out in this column, this position had more or less been already discounted. That this was the case seems to be proved by the fact that the market movements after the publication of the figures were in a downward direction, which seems to show that expectations were not fully realised. There has, however, been a certain amount of recovery since, and values at the time of writing are rather higher on balance than they were a week ago. Copper has lost a little ground, to the extent of several shillings a ton, a firmer tone earlier on not having been maintained. The demand from domestic consumers has shown little indication of expansion, the cable-makers being, perhaps, the most active buying section. Both lead and spelter are cheaper on the week, and in both cases current quotations are lower than they have been even during the last few months' of depressed prices. In neither section of the market has there been any pronounced buying activity.

Iron.

In the local pig iron market things seem to be hanging fire. At times during the last week or two there have been spurts in the demand from users, and although individual orders were not big, the aggregate tonnage booked by some sellers was not unsatisfactory. This week, however, another quiet spell has been encountered, and the present indications are that consumers, for the most part, have sufficient pig iron available to meet their immediate requirements. Virtually all the orders that have been placed during the past few days have been for comparatively early delivery, and there is little disposition to look very far ahead. In spite of the low prices that have lately been ruling in several instances there are certain varieties of pig iron which, even now, can hardly be described as steady, further small reductions in quotations still being reported. For Derbyshire makes, although certain producers are quoting higher figures, round 73s. 6d. per ton, delivered Manchester or equal, is the usual price. Staffordshire is obtainable at 74s. 6d., Middlesbrough at 80s. 8d., and Scottish brands from 92s. 6d. per ton upwards. Lancashire bar iron is still being offered at £10 for Crown and £9 10s. per ton for second quality material, but orders are relatively few and of disappointing volume.

Steel.

There is no change in the basis prices of steel joists and sections, and of ship plates, the official minima remaining at £7 12s. 6d. and £8 7s. 6d. per ton respectively. Boiler plates, however, are somewhat easier at £11 2s. 6d., and the same may be said of steel bars, quotations for which range from £7 15s. to £8 10s. per ton, according to size. Whilst several instances are reported by sellers of British steel on this market where users have not hesitated to sign the rebate agreement, or to express their intention of doing so, there has been no sign yet of any general movement in this direction, and it would not be surprising if, for the time being, many of them were content to "sit on the fence." So far as the merchants are concerned, there is no disguising the fact that, in this part of the country at all events, there is no general love for the scheme as it stands. How far support will come from this quarter will probably depend entirely upon the extent to which acceptance of the agreement would suit their books. The market for imported steels has been somewhat erratic during the week, and prices, if anything, are weaker on balance. There has been more inquiry in the market and rather more actual buying, but keen competition for the business has tested values. Continental sheet bars can be bought here for delivery to Lancashire works for net cash against shipping documents at about £5 6s. per ton, billets at £5 2s. 6d., steel bars at £5 13s., Siemens plates at £7 10s. to £7 12s. 6d., ordinary plates at £7 2s. 6d., wire rods at £6 10s., and joists at about £5 13s. 6d. per ton.

Scrap Metals.

After a period of improved conditions last week interest in non-ferrous metal scrap has died off again. With the exception of lead, however, values generally continue fairly steady. Brass rod turnings are at £39, heavy yellow brass at £44, selected gun-metal scrap at £52 10s., clean light copper at £56, lead at £22, and zinc at £22 10s. for graded qualities, and including delivery to buyers' works.

BARROW-IN-FURNESS.

Hematite.

There is some optimism in the North-West district as far as pig iron is concerned, there being a slight inclination upon the part of customers to place orders with a view to future requirements. There is, however, not much likelihood of there being further reductions in price. Some of the larger customers are still waiting for cheaper iron, and the reduction which took place on the East Coast encourages them to hold out and still to withhold orders for forward delivery. The local steel works are large consumers of iron, and this fact means that stocks cannot increase appreciably at present. Deliveries are mainly of the nature of small parcels to meet immediate requirements. The overseas trade is practically negligible, not much trade being done with the Continent. The iron ore trade is in a moderate condition, and until more furnaces are put in the same conditions will obtain. Foreign ore is being brought in in restricted quantities. The steel trade is fairly well employed at the moment, Barrow being engaged on rails, hoops, &c. Activity will continue for a month or two on the orders held at present, and it is hoped in the meantime that further orders will be booked.

Shipbuilding and Engineering.

H.M.S. Cumberland left Barrow last week for Belfast. She has now returned to Barrow. The reconditioned ship Dorsetshire, which has been altered to serve as a troopship should occasion demand, left Barrow this week, and her sister ship, the Somersetshire, is due for departure in a week's time. It is stated that International Combustion, Ltd., which it was reported some time ago was about to leave Barrow and centralise its activities in Derby, is to remain at Barrow for at least another six months. It is understood that the firm has a large number of contracts in hand.

SHEFFIELD.

(From our own Correspondent.)

Heavy Steel Departments.

THE local steel makers are just about "marking time." Plants are only able to work part time, and orders, which are on the scarce side, barely replace those that have been worked off. It is a very unsatisfactory way of carrying on, but appears to be inevitable under the present uncertain circumstances. Few firms are carrying anything substantial in the way of stock; all through the various processes and departments the policy seems to be to work on a hand-to-mouth policy. There is a good deal of talk about an autumn revival in the iron and steel trades, but general confidence is lacking. Raw and semi-finished material is being bought very cautiously, though more business has been moving in pig iron since the recent reductions in prices. Steel prices have not altered for some time, but buyers of big lots can usually manage to get a concession on the current quotations. Individual firms report improved order books, but there are usually special conditions to account for this; it certainly is not the general experience.

Steel Rebate Scheme.

The steel trade rebate scheme does not apply to Sheffield firms, as these are not makers of the classes of material covered. The Park Gate Iron and Steel Company, Ltd., is the only local firm to figure among the signatories to the scheme, but the Appleby Iron Company, Ltd., and the Frodingham Iron and Steel Company, Ltd., who are also included are, of course, part of the United Steel Companies, Ltd., which undertaking has such big interests in the South Yorkshire area. Sheffield firms are makers of special steels, and these are outside the scope of the scheme. Nevertheless, this proposal for encouraging a greater buying of British steel has aroused considerable interest in this district, and its effect on prices and production will be keenly followed. The users in this district of the constructional steel concerned are chary about expressing any opinion on the scheme.

The Lighter Trades.

These are variable, but, on the whole, they are much better placed than the heavy trades. The call for engineering tools is steady on home account and export business appears to be holding its own. Mining tools are not doing any too well, which one must suppose is only natural with the coal industry passing through such a slack time. Less activity in the building trade is also having an effect. For special quality saws sales are being well maintained, and there are still plenty of overseas buyers who will touch nothing but Sheffield made material in this, as well as in other tool lines. Some very unfavourable reports of foreign-made material have been received from oversea markets. There are no special features to note about the cutlery and plate trades. Although business at the moment is not showing many signs of increased activity, there are indications that retail and wholesale houses are beginning to think it is about time to replenish their stocks. Work from this source has been very scarce all through the summer. One hears more cheerful accounts of the state of the silver trade, and one of the biggest makers tells me that he has a steady output which tends to show that the purchasing power of the public is greater than is sometimes thought. Contracts for shipping companies and hotels are accounting for a good proportion of the output of stainless steel cutlery and plated table ware.

Advertising Scheme.

Some weeks ago I referred to a scheme launched by the Sheffield Chamber of Commerce to advertise the city's manufactures, and in furtherance of this the Chamber has decided to use envelopes upon which will be printed a description of some of Sheffield's products, among them being files and saws, edge tools, machine, joiners' and agricultural tools, railway material, motor and aircraft parts, machinery, cutlery and electroplate. These are declared to be "the best in the world." The Chamber also intends to show cases of Sheffield goods when its new offices in the Cutlers' Hall are completed, and the vestibule of this famous building will be surrounded with a display of finished goods.

Some Recent Contracts.

The Lincoln firm of Ruston and Hornsby, Ltd., has secured from the Crown Agents for the Colonies a contract for pumping plant in connection with Bahamas water supply. The plant comprises two pumps to deliver 500 gallons per minute to a height of 83ft., two electric motors, and two large Ruston oil engines as a stand-by in case of failure of current. The Great Western Railway Company has placed a contract with Joseph Booth and Brothers, Ltd., of Leeds, for the supply, delivery and erection of a 12-ton electric crane for its Temple Meads goods yard at Bristol.

Colliery Developments.

The water-bearing strata has now been passed in the sinking operations for the coal mine at Edwinstowe, in Nottinghamshire, for the Bolsover Colliery Company, Ltd. A depth of 250 yards has been reached. There is another 500 yards or so to go before the seam is reached, but the work will proceed more rapidly now that sinking is being done in dry ground. The cementation process has been used in passing through the water-bearing strata, and the shafts have been lined throughout with concrete. By next May, it is expected, coal will have been struck, and by that time it is calculated £1,000,000 will have been spent on the undertaking. The raising of the coal will be done by electric winders. This plant has already been installed, and is being used in connection with the sinking operations. The winding plant, by the way, is stated to be one of the largest in use, and can raise 4 tons at each winding operation. At the annual meeting in Sheffield of J. Grayson, Lowood and Co., the chairman referred to the new beds of ganister, coal and clay discovered in Wharncliffe Chase. This has helped the company to some extent this year, but they have not been able to proceed very quickly. With the experience of another year's operations in this development, the chairman felt confident that these workings would prove very beneficial to the company and would gradually improve as the workings were opened out. A description of these bed discoveries was given in my letter in THE ENGINEER for August 5th.

New Iron Process.

At Chesterfield last week there was a meeting of creditors of the Hornsey Iron Company, Ltd., which was formed in connection with a project for the low-temperature reduction of iron. The discoverer of the process is Mr. John W. Hornsey, an American engineer, who conducted operations at a special plant which was erected at Sheepbridge, and in which a good deal of local capital was invested. Further capital, however, was needed, but as this was not forthcoming, the concern went into liquidation. Mr. Hornsey returned to America, and curiously enough two days after the creditors' meeting information was received in Sheffield that the United States Steel Corporation are about to begin the manufacture of iron under this process.

All-electric Houses.

In view of the controversies that have taken place up and down the country on the suitability of the all-electric house for families of the working-class type, it is interesting to note that Sheffield Corporation has completed the building of thirty such houses, and is now inviting tenants. Apart from a cooking range in the kitchen and a fire-place in one bedroom, the houses are equipped for electricity only. Tenants will not be allowed to use anything for heating, lighting or power except coal, coke or similar hard fuel in the fire-place. Eight of the houses of the non-parlour type, with two bedrooms, will pay 10s. 0½d. a week in rent and rates, and the remainder, with three bedrooms, will pay 12s. 3d. Electricity engineers may be interested in the following estimates of consumption of electricity and the cost for tenants:—Electric lighting and wash boiler: Total units per annum 568; cost, including all charges, £2 19s. 4d.; lighting boiler and cooker: 2568 units, £9 17s. 8d. Lighting, boiler, cooker, kettle and iron: 2910 units, £11 4s. 3d. Lighting, boiler, cooker, kettle, iron and one fire: 3638 units, £13 13s. 8d.

NORTH OF ENGLAND.

(From our own Correspondent.)

Steel Rebate Scheme.

THE steel makers' rebate scheme designed to overcome the intense and still growing competition of foreign steel in this country is now in operation, and although it is too early yet to anticipate its effect there is a feeling of optimism in North of England trade circles that it will prove an incentive to consumers to come forward with orders in increasing numbers. Already a large number of consumers have intimated their acceptance of the scheme, but some time must elapse before additional business is reflected in increased activity at the works, as many consumers have running contracts with continental manufacturers. After deducting the rebates from the basis prices there still remains a difference in favour of the foreigner, but when the superior quality of the British material is taken into account buyers will serve their own interests, as well as the interest of those engaged in the industry, together with certain supporting industries, such as coal and coke, by purchasing solely home manufactured steel. The question of "extras," however, is one which should receive the careful consideration of British manufacturers. Consumers buying from the Continent obtain an overhead price for their steel, whereas buying from British makers they have to pay for a number of extras for sketch plates, flanging quality, thicknesses, &c., which in effect add 4s. or 5s. to the basis price. This is a real grievance with shipbuilders, who contend that steel makers have done very little to meet them in the direction desired.

Cleveland Iron Trade.

Although the general situation in the Cleveland pig iron trade is still far from what could be desired it is encouraging to note a much brighter tone. Autumn demand now promises to be on a much better scale than has been anticipated. Much of the inquiry circulating is possibly more with the object of testing the strength of the market than with a view to immediately testing placing substantial orders, but rather more business is coming forward, and the outlook is certainly brighter. Local founders and consumers in Scotland are taking more Cleveland iron, but sales to home buyers at a distance and to overseas buyers are still on the small side. A little iron has been sold to the Continent however. Though only sixteen furnaces are producing Cleveland pig iron, the output of that commodity continues rather more than sufficient for current needs, but there now seems prospect of demand being such as to shortly necessitate withdrawals from stock, quotations being on a level that encourages belief that the make of this district will continue to compete successfully, in certain markets, with continental iron. To home buyers No. 1 Cleveland foundry iron is 70s.; No. 3 G.M.B., 67s. 6d.; No. 4 foundry, 66s. 6d.; and No. 4 forge, 66s.; while for shipment to Scotland and to consumers abroad ironmasters' fixed quotations are 2s. 6d. below the foregoing figures.

Hematite Pig Iron.

Both home and export demand for East Coast hematite is improving, and output is stated to be not quite equal to growing needs, but makers still have very heavy stocks and are keen sellers. There are 11 blast-furnaces on the production of hematite pig iron. One or two fair parcels have been sold recently to continental consumers, who stipulated for iron of special analysis. The general market quotation for East Coast mixed numbers is 75s., but it is understood that that figure can still be shaded. No. 1 quality is 75s. 6d.

Ironmaking Materials.

The foreign ore trade continues inactive, consumers having heavy supplies. Nominally quotations remain on the basis of best Rubio ore at 21s. per ton c.i.f. Tees. Makers of Durham blast-furnace coke are experiencing difficulty in maintaining values. They still ask up to 19s. for good average descriptions, but consumers report business on lower terms.

Manufactured Iron and Steel.

Producers of finished iron and steel have a fair number of contracts in hand, and they anticipate an improvement in demand as a result of the rebate scheme. There are no quotable changes to record.

Imports and Exports.

The severity of the foreign competition in the iron and steel trade, which English manufacturers are making a bold bid to counteract, is reflected in the statistics of imports presented at this week's meeting of the Tees Conservancy Commissioners. They covered a period of ten months ending August, and the imports reached the stupendous total of 333,850 tons, as compared with 174,258 tons in the corresponding period of 1925–26, and 53,399 tons in the pre-war period of 1913. Pig iron imported during the ten months amounted to 99,781 tons, as against 45,990 tons for the same months a year ago, and only 312 tons in the pre-war period. Arrivals of crude sheet bars, billets, blooms, slabs, &c., to the end of last month reached 187,211 tons, as against 108,211 tons a year ago, and 33,646 tons in the pre-war period. Plates, bars, angles, rails, sheets, and joists imported totalled 46,828 tons, as against 19,764 tons for the same time a year ago and 19,441 tons in 1913. The aggregate shipments of all classes of iron and steel from the Tees for August reached 88,277 tons, compared with 102,096 tons in July and 85,663 tons in June. Pig iron shipments totalled 13,657 tons, compared with 11,824 tons in July, but the improvement was entirely in the coastwise shipments, only 7727 tons going abroad, compared with 7763 tons in July. The stoppage of the steel works in the district for a week's holiday fully explains the fall in the manufactured iron and steel shipments from 90,272 tons in July to 74,620 tons in August.

The Coal Trade.

It cannot be said that the first week of September has brought anything like the amount of prompt trade that was anticipated. On the contrary, it has been rather disappointing, and it is attributable, perhaps, to the firmer tendency in freights as well as to the lack of demand. Tonnage for outside the coasting areas has been offering in moderate volume, and this has enhanced what were already steady values. It may be, as some people are inclined to believe, that carrying needs are drawing level with, or even surpassing, the available amount of efficient tonnage, and so the freight market is developing strength. While there are hopes that the general prompt position will improve, there is no receding from the idea that a better demand is coming, and so values for the latter part of the month and beyond it are very steady. Tenders are now in for the supplies of considerable quantities of coal to Scandinavia and Finland, and the allocations may be

heard of before the end of the week. Best qualities of Northumberland steams are moving off fairly well, and it is hoped that trade will expand in the near future under growing seasonal demands. Best qualities command 14s. 3d. to 14s. 6d., and seconds 13s. 3d. to 13s. 6d. Steam smalls are in no greater production than requirements justify, and sellers do not deviate from recent quotations. Durham gas coals indicate a satisfactory tone. The demand is improving and prices are firmer at 16s. to 16s. 3d. for best qualities, and 14s. to 14s. 6d. for seconds. Coking fuel is still slow of sale, and more trade would be welcome, particularly on home account. It is difficult to find an adequate market for the output of ordinary foundry coke, which is quoted a shade cheaper. Blast-furnace coke is also lacking in strength. Gas makes, on the other hand, are very steady and well sold for this month.

River Tees Development.

An important step in the further development of the north or Durham side of the river Tees is to be taken by the London and North-Eastern Railway Company, which has secured a track of land from the Tees Conservancy Commissioners for the purpose of linking up Stockton with the Hartlepools by a direct railway. The value of this new railway communication will be readily realised when it is mentioned that it will run through and serve the vast area of foreshore near the mouth of the river which is being reclaimed by the Commissioners for industrial sites.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

THE amount of shipbuilding work on hand compares favourably with previous records, and there appears to be promise of fair employment during the winter. A considerable portion of the work now on hand consists of contracts held up during last year's strike. New business is comparatively slow, and prospects are still dominated to some extent by the continued high costs of production. Whether the latest scheme of the steel makers will have any real effect on costs remains to be seen, but meantime opinions on the point are varied. The Clyde output during August amounted to seventeen vessels of 37,695 tons aggregate, while the returns for this year to date amount to 137 vessels of 203,175 tons aggregate, against 100 vessels of 203,419 tons in the same period last year. Of the vessels launched, four were over 5000 tons each, as follows:—British Valour, oil tank motor vessel, 7000 tons, built for the British Tanker Company, Ltd., London; Lunula, oil tanker, 6500 tons, for the Aral Steamship Company, Ltd. (H. E. Moss and Co.), Liverpool; cargo steamer, 6000 tons, built by Lithgows, Port-Glasgow, to their own account; and the Virgitia, oil tanker, 5700 tons, for G. W. Harrison and Co., Glasgow. During August new contracts reported included two fast cargo vessels for the Hain Steamship Company, a passenger and cargo steamer of 8000 tons gross for Glasgow owners, and a cargo steamer of 6500 tons also for Glasgow owners.

Steel.

The topic of interest has, of course, been the announcement on the part of steel makers of the price rebate scheme. While steel makers profess to be hopeful as to the outcome of their pronouncement, great differences of opinion exist in trade circles, one of the main difficulties being the agreement binding purchasers to home makers. It may be that a way out of all the difficulties may be discovered, and home consumers may find themselves more favourably placed in the matter of costs. Meanwhile, business continues to be quiet generally. Specifications for plates are very slow, and sections are not too well placed.

Steel Sheets.

The inquiry for the lighter gauges of black and galvanised sheets is comparatively well maintained, and order books are fairly heavy. Some makers report that outputs of light sheets and galvanised corrugated sheets are on a level with pre-war records. The heavier gauges still meet strong opposition from the Continent, and are not particularly well placed.

Iron.

The demand for bar iron remains poor, and unpromising. The home price is unchanged, but the export quotation can be shaded for a good specification. Steel bars re-rolled from foreign billets also are somewhat neglected, in spite of price reductions, and works are poorly employed.

Imports and Exports.

Arrivals of iron ore at Glasgow last week totalled 13,500 tons, while manufactured iron products amounted to about 1400 tons. Shipments of manufactured iron reached a total of 5500 tons.

Coal.

There has not been any change of importance in the Scottish coal trade. The export demand continues to be disappointing, and home requirements expand slowly. Practically all descriptions of round coal are in need of fresh business and small stuffs show a weakening tendency. The Scottish portion of the Finnish State Railway contracts just announced amounts to 5000 tons of Lothian prime steams, the tender being that of a Glasgow firm of shippers. Aggregate shipments during the past week amounted to 248,371 tons, against 211,294 tons in the preceding week, and 275,087 tons in the same week in 1925.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

NOTHING has happened during the past week to give a better tone to the steam coal market. At the end of that week there were thirty-three tipping appliances idle at the various local docks, and on Monday the position was not improved to any appreciable extent as the result of arrivals of tonnage over the week-end, inasmuch as twenty-nine loading berths were still vacant. It will be seen therefore from these figures that there is no loading pressure; on the contrary, the conditions are easy and all collieries can do with considerably more prompt business to place them in a comfortable situation and enable them to avoid temporary stoppages. It is a fact that of late an increased amount of business has been transacted, but it is quite inadequate to the needs of this market. Shipments for the week ending the 2nd inst. were disappointing, as the total was only 384,194 tons, as compared with 435,429 tons for the previous week. It is very clear that substantially more orders and tonnage are required to give a fillip to the market, and provide anything like regular employment in the coalfield. So far as fresh inquiries are concerned, the Latvian Railways are in the market for 50,000 tons of large steams, and there is a Brazilian inquiry for 15,000 best Admiralty large coal for early shipment. The Norwegian State Railways and Navy have asked for prices for about 8000 to 10,000 tons of large, including 2500 tons of double screened, for delivery up to the end of November, while it is understood that the Portuguese State Railways have contracted for the 50,000 tons of large and small coals for which they recently sought tenders. In the case of the Egyptian State Railways, business for 125,000 metric tons of large steam coals, for which Watts, Watts and Co., Ltd., put in the lowest price of 28s. 3d. c.i.f. Alexandria, it appears that up to the time of writing this contract had not been definitely allocated. Owing to the death of Zaghoul Pasha, the adjudication was deferred until the 6th inst., and by agreement the tender of Watts, Watts and Co., Ltd., holds good until the 10th inst.

Coal Trade Finances and Wages.

The announcement was made at the end of last week by Mr. Finlay A. Gibson, the secretary of the Coalowners' Association, that the report of the joint accountants appointed under the South Wales Conciliation Board Agreement for the three months May, June and July had been received, and revealed a financial position more unsatisfactory than that for the three preceding months. Under the agreement of December last the percentage payable on the standard rate is ascertained by taking 85 per cent. of the difference between the proceeds and the costs of production other than wages. By this procedure the accountants certify the percentage payable as only 0·45 per cent. above the 1915 standard base rates, compared with 16·09 per cent. under the audit for the three months ending April last. The workmen, however, are guaranteed a minimum percentage of 28 per cent. on the 1915 standard base rates, so that during the next three months the coalowners will have to bear practically the whole of the burden of the minimum percentage. The actual trading loss suffered during the three months was £573,929, which is equivalent to 1s. 0·36d. per ton on the output, compared with a loss in the previous three months of £216,776, or 4·41d. per ton. Over the six months, therefore, there has been an aggregate loss of £790,705. This loss was caused partly by a fall in prices and partly by a diminution in the quantity of coal produced. In the pit-head proceeds there was a reduction of 9¾d. per ton, viz., from about 15s. 3¾d. to 14s. 5¾d., while in the quantity of coal produced there was a decrease of about 650,000 tons, viz., from 11,788,224 tons to 11,138,718 tons. The output per man-shift was 19·96 cwt., compared with 20·36 cwt. in the preceding quarter, while in the same comparative periods the earnings per shift fell from 10s. 6·49d. to 10s. 2·34d. The wages cost per ton was 10s. 2·55d., compared with 10s. 4·27d. in February, March and April.

Current Business.

The tone of the steam coal market has not undergone any change during the past week. In all departments quotations are nominally the same, and so far as most descriptions of large coal are concerned, supplies are plentiful for prompt loading. The only section of the market which continues to display any real strength is that for smalls and washed coals, the output of which is insufficient to meet the demands of buyers. In some areas efforts are being made to stamp out non-unionism, and it is possible there may be temporary stoppages of work on this account; but apart from causing inconvenience to some buyers and individual undertakings, it is questionable whether they will have any effect upon the general market owing to the plentiful supply of similar coals. Patent fuel and coke remain quiet markets, but pitwood is a shade steadier.

CONTRACTS.

THE POWER PLANT COMPANY, Ltd., of West Drayton, Middlesex, has secured a contract from Nusckewerft, Stettin, Germany, for turbine double reduction gears for two new steamers. The gears will be of the overhead design, and will transmit 3300 S.H.P. per shaft.

THE MIRRLEES WATSON COMPANY, Ltd., Scotland-street, Glasgow, informs us that the capacity of the bore-hole pump for the Chiltern Hills Water Company, the receipt of the contract for which was announced in our issue of September 2nd, is 30,000 gallons per hour, and not 3000 gallons per hour, as we inadvertently stated it to be.

THE Spanish Northern Railway has placed an order with Brown, Boveri and Co., Ltd., Baden, Switzerland, for two express locomotives for trial purposes intended for use on the Hendaye-Alsasua section of the line, which is to be electrified. The locomotives will be of the 2 C–C 2 class and will be designed for a 1500-volt direct-current supply and a gauge of 1674 m. The builders' individual axle drive will be used, each driving axle having its own motor. On a one-hour rating the output will be 3240 H.P. at 35 m.p.h., the maximum speed under power being 68 m.p.h. The axle load is limited to 16 tons, and the total weight will be 136 tons. The locomotive will be arranged for regeneration.

EDUCATIONAL INTELLIGENCE.

CITY OF LONDON COLLEGE.—A course of twenty-five lectures on "Iron and Steel" will be given at the City of London College, Moorfields, on Tuesdays, 6.30 to 7.30, commencing on Tuesday, September 20th, 1927, and a course of twenty lectures on "Special Steels and Non-ferrous Metals," on Thursdays, 6.30 to 7.30, commencing on Thursday, September 22nd, 1927, will be given by Mr. T. Barton Kelly.

CHELSEA POLYTECHNIC.—A course of day and evening classes in "Metallurgy" has been arranged at the Chelsea Polytechnic, Manresa-road, Chelsea, and will begin on September 21st, 1927. The general courses are suitable for:—(*a*) Students desiring to become industrial and analytical metallurgists, mining and metallurgical engineers; (*b*) candidates for the London University Degree in metallurgy, the Institute of Chemistry Diploma in metallurgical chemistry and technical students; (*c*) assayers, analytical and consulting chemists and engineers. The engineering metallurgy courses are suitable for:—(*a*) Those engaged in the various branches of the metallurgical and engineering industry; (*b*) candidates for the Institution of Mechanical Engineers' Associate Membership Examination. Full particulars can be obtained from the Polytechnic.

THE Industrial Welfare Society's eighth annual lecture conference opens at Balliol College, Oxford, to-day. The list of lectures is as follows:—Friday, 9th, 8.30 p.m., opening address, by Sir Harold Morris. Saturday, 10th, 10.15 a.m., lecture, "Welfare Work in a Mining Community," by Mr. R. A. Burrows. Sunday, 11th, 4.30 p.m., lecture, "The Educational Needs of the Adult Worker," by Mrs. Barbara Wootton; and 8 p.m., lecture, "The Encouragement of Singing and the Appreciation of Music," by Sir Richard Terry; Monday, 12th, 10.15 a.m., lecture, "Staff Welfare and its Effects upon Efficient Salesmanship," by Miss G. Burlton; 8 p.m., lecture and demonstrations, "The Technique of Modern Selection," by Mr. G. W. Reid; Tuesday, 13th, 10.15 a.m., short papers, "Sickness in Relation to its Cost to Industry," by Miss G. F. McArthur; "The Educational Aspect of Industrial Welfare," by Mr. F. W. James; 2.30 p.m., lecture, "A Critical Survey of Personnel Administration," by Mr. H. C. Emmerson. The lectures will be followed by one hour's discussion.

CATALOGUES.

TANGYES, Ltd., Cornwall Works, Birmingham.—Catalogue No. 343 on cold starting heavy-oil engines.

THE CAPAC COMPANY, Ltd., 24, Bruton-place, W. 1.—Full particulars of Bin-aural equipment for testing machinery.

CLAYTON WAGONS, Ltd., Lincoln.—Publication 107 illustrating and describing the "Clayton" light steam locomotive.

H. J. SCOTT AND CO. (Belfast), Ltd., Ravenhill-avenue, Belfast.—Revised price list of alternating-current induction motors.

HOPKINSONS, Ltd., Britannia Works, Huddersfield.—List No. 2040 dealing with the firm's patent all-metal draught gauges.

JOSEPH FOSTER AND SONS, Soho Foundry, Preston.—Folder containing details of various chemical plant manufactured by the firm.

MAVOR AND COULSON, Ltd., 47, Broad-street, Mile End, Glasgow.—Particulars of oil immersed rotor starters and ironclad distribution panels.

HERBERT MORRIS, Ltd., Loughborough.—Book 132 illustrating the numerous classes of work for which the "Morris" electric telpher can be adapted.

ROSS PATENTS, Ltd., Abbey House, Victoria-street, S.W. 1.—Leaflet No. 5-27, the Ross feeder and the Ross feeder-screen for ores, stones, gravel, slag, coke, coal, &c.

SIR W. H. BAILEY AND CO., Ltd., Salford, Manchester.—Pamphlet No. 1727 dealing with a single-lever deadweight tester for tensile, transverse and crushing tests to 10 tons.

C. R. AVERILL, Ltd., 22, Duke-street, S.E. 1.—A booklet entitled "A Tale of Yesterday, To-day and To-morrow," by F. W. Parsons. The booklet describes the growth of the Joseph Dixon Crucible Company, Jersey City, N.J., U.S.A., for whom Messrs. C. R. Averill, Ltd., act as agents.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., Rugby.—List 3316, "Metal-clad Compound-filled Switchgear;" List 4172, "Oil-immersed Circuit Breakers;" List 3120-B, "Alternating-current Switchboards;" List 5673, "Direct-current Push-button Contactor Control Equipments;" List 3312, "Truck Type Switchgear."

THE BRITISH BEET GROWER AND EMPIRE SUGAR PRODUCER.—A good indication of the progress of the sugar-beet industry in this country is given by the appearance of a monthly newspaper devoted to its interests. The first issue of this periodical dated September, 1927, lies before us. It is well printed and illustrated, and has as its principal article a contribution by Lord Denbigh, of whom it speaks as "the father of the British Beet Sugar Industry." We hope that the progress of the paper may be insured by the development of the industry which it represents.

FIRE RESISTANT CONSTRUCTION.—The Department of Scientific and Industrial Research has just published "Building Research," Special Report No. 8, dealing with "Fire Resistant Construction." This report concerns the resistance of building materials to fire. Part I. contains a brief outline of the effect of high temperatures upon materials in general, metals, timber, natural stones, bricks, &c.; while Part II. is devoted to the fire-resistance of concrete. The deterioration produced in concrete by fire is shown to be due to two main causes, one being the thermal expansion of the aggregate and the other the presence of free lime, which is dehydrated at the temperature attained in a building conflagration and slakes with expansion on subsequent exposure to moisture, causing complete failure of the structure. The tests reported show that a good deal of the free lime in Portland cement concrete may be absorbed by the addition of pozzolanas, the resultant concrete showing in some cases a considerable degree of stability when exposed to high temperatures; the value of various pozzolanas for the purpose is discussed. Research on the lines of the work described in the report is still proceeding. The special mixtures of Portland cement and pozzolanas have been kept under observation for over two years, both in the normal condition and after exposure to fire, and seem perfectly reliable. A further report will be published after five years' experience has been obtained. The report may be obtained from his Majesty's Stationery Office, price 1s. 6d., postage extra.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/–
(1) Spanish	18/6 to 21/–
(1) N. African	18/6 to 21/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	21/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(3) SCOTLAND—		
Hematite	3 17 0	—
No. 1 Foundry	4 0 0	—
No. 3 Foundry	3 15 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 15 0	3 15 0
No. 1	3 15 6	3 15 6
Cleveland—		
No. 1	3 10 0	3 7 6
Silicious Iron	3 10 0	3 7 6
No. 3 G.M.B.	3 7 6	3 5 0
No. 4 Foundry	3 6 6	3 4 0
No. 4 Forge	3 6 0	3 3 6
Mottled	3 5 6	3 3 0
White	3 5 6	3 3 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
„ „ Foundry	3 5 0 to 3 6 0	
(3) Northampton—		
Foundry No. 3	3 1 0	—
Forge	2 17 0	—
(3) Derbyshire—		
No. 3 Foundry	3 5 0	—
Forge	3 5 6	—
(3) Lincolnshire—		
No. 3 Foundry	3 5 0	—
No. 4 Forge	3 5 0	—
Basic	3 7 6	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 8 6 (a) / 4 11 6 (b) / 4 15 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 15 0	10 10 0
Best	—	
N.E. COAST—		
Iron Rivets	12 5 0	—
Common Bars	11 5 0	—
Best Bars	12 5 0	—
LANCS.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	14 0 0	—
S. YORKS.—		
Crown Bars	11 10 0	—
Best Bars	12 5 0	—
Hoops	14 0 0	—
MIDLANDS—		
Crown Bars	10 5 0 to 10 10 0	
Marked Bars (Staffs.)	13 10 0	—
Nut and Bolt Bars	9 15 0 to 10 0 0	
Gas Tube Strip	11 17 6 to 12 0 0	

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	11 0 0
Ship Plates, ½in. and up	8 2 6	7 12 6
Sections	7 12 6	7 2 6
Steel Sheets, under 3/16in. to ½in.	10 5 0 to 11 5 0	
Sheets (Gal. Cor. 24 B.G.)	— £14 5 0 to 15 5 0	

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 2 6	—
Angles	7 12 6	—
Boiler Plates	12 10 0	—
Joists	7 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	
Billets	7 10 0 to 10 0 0	
MANCHESTER—		
Bars (Round)	8 12 6	—
„ (Small Round)	7 17 6	—
Hoops (Baling)	11 0 0	11 0 0
„ (Soft Steel)	10 0 0	10 0 0
Plates	8 7 6	—
„ (Lancs. Boiler)	11 2 6	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Hard Basic	8 2 6 to 8 12 6	
Intermediate Basic	7 12 6	—
Soft Basic	7 0 0	—
Hoops	11 10 0	—
Soft Wire Rods	9 5 0	—
MIDLANDS—		
Small Rolled Bars	7 15 0 to 8 0 0	
Billets and Sheet Bars	6 10 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	14 0 0 to 14 2 6	
Angles	7 12 6	—
Joists	7 12 6	—
Tees	8 12 6	—
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/4½ to 18/7½
Block Tin (cash)	290 0 0
„ (three months)	284 10 0
Copper (cash)	54 13 9
„ (three months)	55 5 0
Spanish Lead (cash)	22 1 3
„ (three months)	22 12 6
Spelter (cash)	27 10 0
„ (three months)	27 12 6
MANCHESTER—	
Copper, Best Selected Ingots	61 10 0
„ Electrolytic	62 7 6
„ Strong Sheets	86 0 0
„ Tubes (Basis Price) lb.	0 1 0½
Brass Tubes (Basis Price), lb.	0 0 11½
„ Condenser, lb.	0 1 1½
Lead, English	23 15 0
„ Foreign	22 10 0
Spelter	27 15 0
Aluminium (per ton)	£107

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8½ per lb.	
Ferro Tungsten	1/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 10 0	7/6
„ „ 6 p.c. to 8 p.c. „	£22 15 0	7/3
„ „ 8 p.c. to 10 p.c. „	£22 7 6	6/8
„ „ Specially Refined		
„ Max. 2 p.c. carbon	£36 5 0	11/6
„ „ „ 1 p.c. „	£42 5 0	15/–
„ „ „ 0·70 p.c. carbon	£54 0 0	17/6
„ „ „ carbon free	1/4 per lb.	
Metallic Chromium	3/– per lb.	
Ferro Manganese (per ton)	£12 10 0 for home, £16 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 12 6 scale 5/– per unit	
„ „ 75 p.c.	£19 5 0 scale 6/– per unit	
„ Vanadium	14/3 per lb.	
„ Molybdenum	5/– per lb.	
„ Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Ferro-Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.
(*Prices not stable.*)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/–
„ „ Ell	13/3 to 13/6
„ „ Splint	15/6 to 17/6
„ „ Trebles	14/– to 14/3
„ „ Doubles	13/3
„ „ Singles	12/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/3
„ „ Jewel	15/6
„ „ Trebles	15/– to 15/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	11/9 to 13/9
Screened Navigation	18/–
Trebles	15/–
Doubles	13/3
Singles	13/–
LOTHIANS—	
(f.o.b. Leith)—Best Steam	12/9 to 13/–
Secondary Steam	12/3
Trebles	15/3
Doubles	13/9
Singles	12/9

ENGLAND.

(8) N.W. COAST—	
Steams	24/– to 25/9
Household	42/6 to 58/6
Coke	23/6 to 25/–
NORTHUMBERLAND—	
Best Steams	14/6
Second Steams	13/3 to 13/6
Steam Smalls	10/6
Unscreened	13/– to 13/6
Household	21/– to 27/–
DURHAM—	
Best Gas	16/– to 16/3
Second	14/– to 14/6
Household	21/– to 27/–
Foundry Coke	19/– to 26/–

SHEFFIELD—	Inland.	
Best Hand-picked Branch	27/6 to 28/6	—
Best Selected House Coal	21/– to 22/6	—
Screened House Coal	19/– to 21/–	—
„ „ Nuts	16/– to 17/6	—
Yorkshire Hards	16/– to 17/–	—
Derbyshire Hards	16/– to 17/–	—
Rough Slacks	9/6 to 10/6	—
Nutty Slacks	7/6 to 8/6	—
Smalls	3/– to 5/6	—
Blast-furnace Coke (Inland)	21/– to 22/–*	—
„ „ (Export) f.o.b.		20/– to 21/–

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	20/– to 20/6
Second Smokeless Large	19/– to 19/6
Best Dry Large	19/– to 19/6
Ordinary Dry Large	18/– to 18/6
Best Black Vein Large	18/3 to 18/6
Western Valley Large	18/– to 18/3
Best Eastern Valley Large	17/6 to 18/–
Ordinary Eastern Valley Large	17/– to 17/6
Best Steam Smalls	14/– to 14/6
Ordinary Smalls	12/– to 13/6
Washed Nuts	18/– to 21/6
No. 3 Rhondda Large	20/– to 20/6
„ „ Smalls	16/– to 16/6
No. 2 „ Large	17/– to 17/6
„ „ Through	16/– to 16/6
„ „ Smalls	13/– to 14/–
Foundry Coke (export)	35/– to 40/–
Furnace Coke (export)	27/6 to 30/–
Patent Fuel	23/6 to 24/6
Pitwood (ex ship)	32/6 to 33/–
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	37/– to 40/–
Seconds	28/– to 32/6
Red Vein	25/– to 30/–
Machine-made Cobbles	42/6 to 45/–
Nuts	42/6 to 47/–
Beans	30/– to 32/6
Peas	18/6 to 20/6
Breaker Duff	8/– to 9/–
Rubbly Culm	9/6 to 10/–
Steam Coals:	
Large	18/6 to 19/6
Seconds	17/6 to 18/–
Smalls	10/6 to 12/–
Cargo Through	15/6 to 16/–

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.
(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (*d*) Rebate 7/6 joists and 5/– all other materials if home consumers confine purchases solely to British products. * Official quotation for pig iron producers

French Engineering Notes.

(*From our Correspondent in Paris.*)

Over-Production.

THE consumption of iron and steel has fallen to a point at which it is so far below the production as to leave a considerable surplus which must continue to weigh heavily on the market unless something is done to restrict output or to provide new outlets. It is evident that a time must come when there will be a steady increase in the world's demands, and the longer it is delayed the greater will be the deficiency to make up. While at home enterprise is held up for financial reasons and the execution of new public works is more or less in abeyance, there is a considerable contraction in the requirements of some foreign markets, principally in the Far East, where business is almost entirely suspended, but even in such cases the requirements in iron and steel are merely deferred, and there is a general impression that if only it were possible to overcome economic and other difficulties, there would be a great industrial revival everywhere. Unfortunately, there is nothing to indicate that such a revival will take place at an early date. The problem is too involved and complicated to be settled out of hand, and despite the efforts of international commissions to provide a solution, it is probable that industry will finally work out its own salvation as the result of facilities offered by international commercial agreements. The production is probably not in excess of the normal needs of the Continent, augmented by colonial demands and the requirements of Eastern markets, and there can be no question of reducing it permanently. Makers are only anxious to tide over a difficult period, which is likely to be long, and the only way of doing so is by the temporary restriction of output now being imposed by the Steel Cartel as well as the maintenance of prices at a reasonable profit-making level by the creation of international sales organisations. It is believed that at the end of the month the Cartel will reduce the output for the last quarter of the year, although Germany will probably still be opposed to any considerable reduction unless German makers are assured of being able to supply all the needs of their own market. At the same time the constitution of the sales organisations will come up for discussion, and if it be found possible to arrive at some definite settlement for girders, it is probable that efforts will be made to extend the system to all descriptions of rolled steel. On account of the claims of the different countries interested the negotiations are extremely arduous, but it is fully recognised that a policy of general restriction and organisation will, alone, enable the industry to pass successfully through a period which may become still worse before a turning point is reached.

Railway Material.

The orders that were distributed some time ago have been keeping wagon builders fairly well employed, but as no new work is coming to hand, and as there seems little prospect of the railway companies purchasing any large amount of material, the situation of the builders is once again becoming serious. It is quite evident that the railway companies are unable to embark upon any expenditure that can possibly be avoided. They gave out orders at a time when the Government found it necessary to react against the pessimism which was caused by the sudden collapse of industrial activity following upon the stabilisation of the franc. Since then the situation of the companies has become worse on account of the steadily falling traffic receipts. It was expected that the several increases in railway rates would have improved the financial position of the companies, but, whatever may have been the results as regards passenger traffic, it is certain that goods traffic has considerably declined, although it is difficult to say whether this fact should be attributed wholly to the industrial stagnation. Makers have all along declared that the higher rates helped to accentuate the decline in trade. However this may be, it is clear that wagon builders see little hope of securing many orders unless they are able to finance buyers. For some time past there has been in existence the Société Financière et Industrielle des Chemins de Fer, which provides financial assistance to locomotive and wagon builders in obtaining and executing contracts, but efforts are being made to increase its scope so that it will be possible to accept contracts on conditions of payment by annuities. Builders believe that if they were able to accept contracts on these terms the railway companies would not hesitate to place them, and the builders themselves would be in a better position to compete for foreign orders. They also affirm that they must have the minimum protection proposed under the new Tariff Bill of 15 per cent. *ad valorem* upon railway rolling stock.

Steel Coaches.

It is pointed out that the fact that six Pullman cars remained on the road in the accident to the Paris-Bordeaux express near Tours during Thursday night of last week is evidence of the greater security offered by steel coaches. The cars appear to have suffered no damage beyond the breaking of glass. The accident seems to have been caused by the criminal removal of the bolts holding the rails over a distance of about 45ft., so that when the locomotive reached that section of the track the rails spread out. The locomotive ploughed along the permanent way for some little distance, and then turned over between the two tracks, the driver being killed by the coal which fell upon him from the tender as it rose behind and fell at right angles to the locomotive. The train carried mostly British and American passengers who were journeying to the south. The fact that there was no great loss of life is attributed to the circumstances that the train was at the time travelling at about 45 miles an hour instead of at the maximum of 75 miles allowed on this part of the road, and to the rupture of the brake pipe, whereby the coaches were automatically braked and telescoping prevented. In all other railway accidents in which steel coaches have been involved, they have resisted the shock far better than the wooden coaches, and as the risk to passengers is thereby diminished, it has been decided to build all coaches for express trains of steel.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

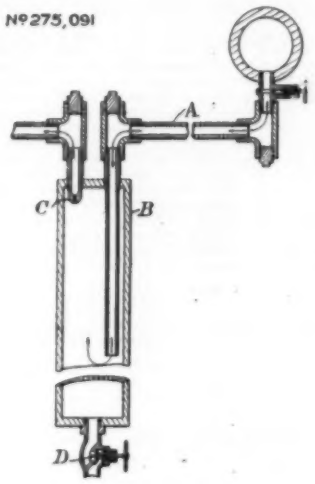
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

275,091. February 7th, 1927.—BLOWING DOWN BOILERS, E. Caldwell, 2809, Carlisle-road, Birmingham, Alabama.

In this specification the inventor urges that the periodical blowing down of a boiler is not fully effective in the elimination of scaling as, in the intervals between blowing down, the scale-forming constituents of the feed-water accumulate in the boiler.

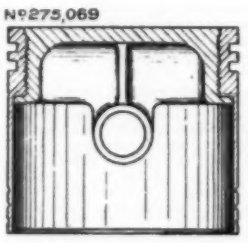


As a consequence he proposes the continuous extraction of a small proportion of the water in the boiler from the lowest part of the shell. This water is drawn off from the boiler by the pipe A, and taken into a tall drum B, from which its escape is regulated by the size of the orifice C. Any mud which may accumulate in the drum can be discharged through the valve D.—*August 4th*, 1927.

INTERNAL COMBUSTION ENGINES.

275,069. December 17th, 1926.—PISTONS, The Midland Motor Cylinder Company, Ltd., Dartmouth-road Foundries, Smethwick, and P. Pritchard.

A piston according to this invention consists of a tubular shell of steel or cast iron forming the walls and skirt of the piston, and carrying the grooves for the piston rings, and an aluminium head which carries the mounting or bearings for the gudgeon pin.

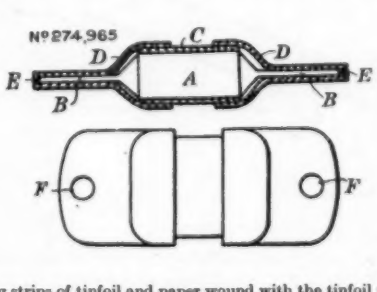


The head is pressed or screwed into the shell and is located either by a flange at its lower end which abuts against an internal shoulder, formed by a thickening of the upper part of the shell, or by an external flange or shoulder which seats on the end of the shell. In either case the head is locked by pressing or forcing over the periphery of the end remote from the flange or shoulder into or against an annular groove or inclined recess in the shell. —*August 4th*, 1927.

ELECTRICAL APPLIANCES.

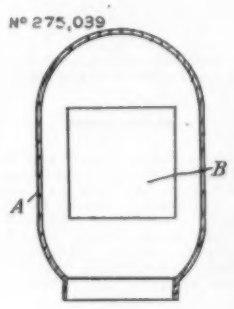
274,965. April 29th, 1926.—ELECTRIC CONDENSERS, The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C. 2; L. Griffiths, 18, Grafton-street, Coventry, and C. J. Morton, Amulree, St. Paul's-road, Coventry.

This invention relates to electric condensers of the type comprising strips of tinfoil and paper wound with the tinfoil portion projecting at the ends and has for its object the provision of improved means for sealing such condensers to the exclusion of moisture. Referring to the drawings, the condenser comprises a body portion A formed of strips of tinfoil and paper and tinfoi projections B at the ends of the body portion. A strip C of presspahn or other suitable material is wrapped round the condenser body A and tubular metal terminal clips D are assembled on the condenser as shown and pressed at their outer ends to ensure good electric contact with the tinfoil projections B. After the clips D have been assembled, the condenser body is given a coating of cellulose or other suitable varnish to seal up the joints between the clips and the condenser body and render the condenser immune from moisture effects. The outer ends of the terminal clips D are soldered at E to the tinfoil projections B. Holes F are formed in the ends of the condenser unit for attachment purposes.—*July 29th*, 1927.



275,039. September 25th, 1926.—SHIELDING ELECTRICAL INDUCTANCES, B. Hesketh, Wexham-road, Slough, Bucks.

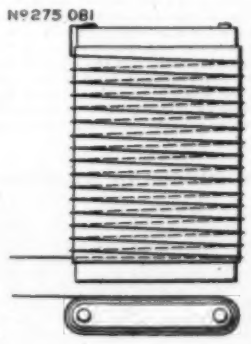
The essence of this specification is contained in the following claim, which reads :—A method of shielding an electrical induct-



ance characterised by the construction of the shield so that it conforms substantially to the shape of the field around the inductance. On reference to the diagram it will be seen that the contour of the shield A conforms closely to that of the field of the inductance B.—*August 4th*, 1927.

275,081. January 20th, 1927.—ELECTRIC CONDENSERS WITH RESISTANCES, The Dubilier Condenser Company (1925), Ltd., Victoria-road, North Acton, London, W. 3.

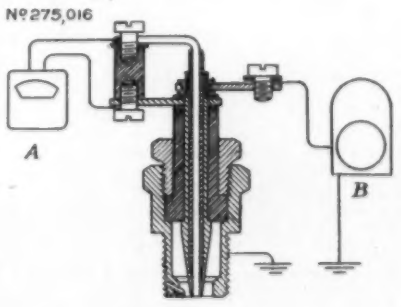
The object of this invention is to minimise the sparking which occurs when an electric circuit is opened. To this end a resistance and a condenser are connected in series and are coupled up in the circuit. It appears that the peculiar feature lies in the fact that the resistance is wound round the outside of the condenser, as shown in the illustration.—*August 4th*, 1927.



MEASURING AND TESTING INSTRUMENTS.

275,016. August 3rd, 1926.—PYROMETERS FOR INTERNAL COMBUSTION ENGINES, C. E. Foster, Elm Tree House, Letchworth-lane, Letchworth.

In this specification the inventor points out that it is physically impossible to measure the temperature of the interior of internal combustion engine cylinders instantaneously at any definite point in the cycle, on account of the speed at which they run.

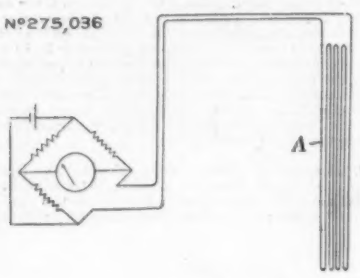


It is, however, useful to know the mean temperature. He measures this mean temperature by using the sparking plug as a thermo-couple. As shown in the illustration, the central rod of the plug is formed of a wire and a surrounding sleeve of dissimilar metal, separated by an insulator, but connected together at the lower end. This thermo-couple, in conjunction with a milli-ammeter A, serves to measure the temperature. The usual ignition magneto is shown at B.—*August 4th*, 1927.

275,036. September 9th, 1926.—CHECKING THE TEMPERATURE OF GRAIN SILOS, C. E. Foster, Elm Tree House, Letchworth-lane, Letchworth.

The inventor asserts that the apparatus commonly employed for the determination of the temperature of grain silos is unnecessarily complicated, and may extend to as many as 500 separate thermometers in a single installation. He proposes that instead of having, say, ten resistance thermometers arranged at different levels throughout each silo, only one should be installed in each. Then if a reading on any one silo thermometer shows an undue rise, the normal thermometer in that silo is removed, and its place is taken by an exploratory

thermometer, with which the exact locality of the overheating may be discovered. The diagram shows a thermometer resist-

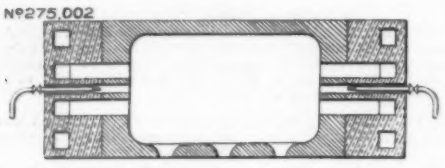


ance bulb A connected with a Wheatstone bridge for the detection of any rise in temperature.—*August 4th*, 1927.

FURNACES.

275,002. June 28th, 1926.—OPEN-HEARTH STEEL FURNACES, B. Zwiebel, Gogol-street, No. 19, Leningrad, Russia.

This invention is concerned with the manufacture of steel which may be directly cast into ingots. The furnace itself is of more or less normal form, but has the addition of nozzles, through which a "heavy hydrocarbon" may be sprayed on to the surface of the melt in order to produce a reducing atmosphere. It is hinted that coal tar may be used for the purpose. It is explained that the blowing in of the heavy hydrocarbon may be commenced

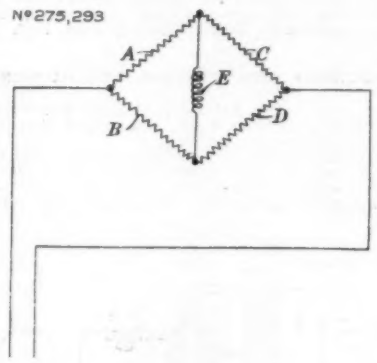


as required after melting of the charge, this depending on the mechanical properties which the finished metal is to have. Thus, for instance, in the manufacture of steel of different kinds, the following data have been ascertained:—In the case of hard steel the blowing in of the hydrocarbon is commenced when the material commences to seethe; in the case of steel of medium hardness, the correct moment is when it has been ascertained that the material has a suitable content of carbon; in the case of soft steel the blowing in of heavy hydrocarbons only commences when the material has finished seething.—*August 4th*, 1927.

LIGHTING AND HEATING.

275,293. April 10th, 1926.—IMPROVED MEANS FOR PREVENTING ELECTRICAL RESISTANCES FROM BEING OVERHEATED, The Rheostatic Company, Ltd., and Leonard Satchwell, both of 31, Mackenzie-street, Slough, Buckinghamshire.

In connection with resistance units for converting electrical energy into heat energy it is frequently desirable to have some means of interrupting the supply of energy passing through the resistance should the resistance reach too high a temperature, and the object of this invention is to provide means for interrupting the circuit. In the diagram below, A, B, and C are standard grid resistances arranged as three arms of a Wheatstone bridge and supplemented by the arm D formed by a grid with

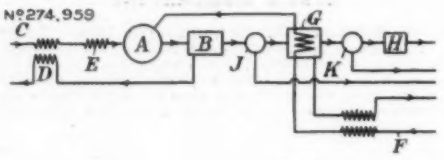


a low temperature coefficient, all arms being of the same ohmic value at normal temperature. A relay E is connected across the junction of the arms A and C and the junction of the arms B and D. At normal temperatures there is no potential difference across the relay coil E, but as the resistance comprising the four arms A, B, C, and D become hot the resistance of the three arms A B C increases in value whilst the resistance value of the fourth arm D remains more or less constant, and therefore a potential difference is created between the junction of the arms A and C and the junction of the arms B D. A current consequently flows through the relay coil E, thereby actuating a circuit breaker.—*August 10th*, 1927.

MISCELLANEOUS.

274,959. April 28th, 1926.—DISTILLATION OF CRUDE OILS F. Tinker, Westfield, Foley-road, Streetley, Sutton Coldfield.

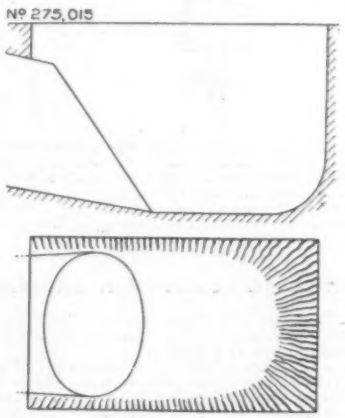
The object of this invention is to provide a distillation system in which heat exchange can be carried out more effectively and economically, and to an extent further than is usual, and in such a way that the different parts of the plant are capable of independent control. Among the alternative arrangements described in the specification that shown in our illustration comprises a topping plant which is fed, instead of by one stream of crude oil, as is usual, by two streams of crude oil merging after preheating in the manner outlined below, into any suitable mixing chamber A. In this chamber the streams commingle at the top and flow downwards over baffle plates, and thence pass into any suitable separating drum B wherein the liquid oils of the mixed stream are separated from the entangled vapours. The crude oil stream flowing in the pipe C is preheated on its way to the mixing chamber A firstly by indirect heat exchange (in the heat exchanger D) with the liquid residuum flowing from the separating drum, and secondly by a fire-heated pipe still E, where it can be raised to any desired temperature immediately before entering A. The crude oil stream in the pipe F is preheated firstly by indirect heat exchange (in a heat exchanger) with the liquid distillate refluxed from the fractionating system, and secondly by a vapour heat exchanger G, in which considerable volumes of the medium and heavier vapours flowing from the separating drum towards the water condenser H are fractionally condensed by means of a coil or pipes inserted therein through which flows the crude oil stream F. On either side of the fractional condenser or vapour heat exchanger G it is convenient to place two fractionating columns J and K, so that the grade of distillage condensed in G can be controlled. H in the diagram is an ordinary water cooled condenser which condenses the light oils escaping liquefaction in J, G and K. It is clear that the coil



or pipe area in G can be made of such a size, and the amount of the crude oil stream F regulated in such a way, that the desired amount of condensation of medium and/or heavy fractions can be obtained in G and the crude oil stream F raised to something like the desired distillation temperature before it commingles with the crude oil stream C in mixing chamber A. It is likewise clear that the temperature of the mixed stream can be controlled by imparting a little, more or less, heat as may be required to the crude oil stream C by means of the fire-heated pipe still E. It is evident also that a supplementary indirect heat exchanger between condensing vapours and a further crude oil stream might be placed in the vapour path between K and the water condenser H. If this were done it would be advisable to pass this third stream of crude oil through a pipe still before introducing it into the mixing chamber A.—*July 28th*, 1927.

275,015. July 30th, 1926.—THE ARTIFICIAL DRYING OF CROPS, Dr. B. J. Owen, University of Oxford.

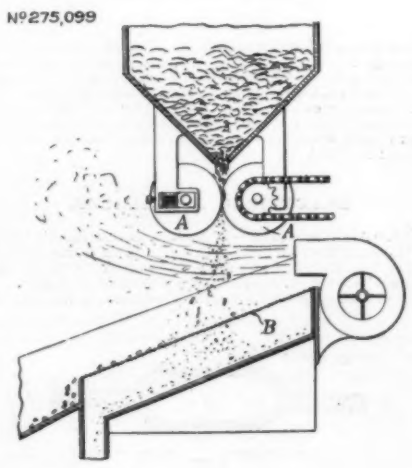
In view of our previous references to Dr. Owen's system of drying agricultural crops by means of preheated air, we include



this specification among our selection; but it would seem that the only claim is for the formation, shown in the drawing, of the passage-way dug in the ground below the stack which is to be dried, for introducing the hot air to the centre of the stack.—*August 4th*, 1927.

275,099. February 14th, 1927.—PURIFYING IRON SCALE, A. Lucas, 5908, Cherry-street, Kansas, Missouri.

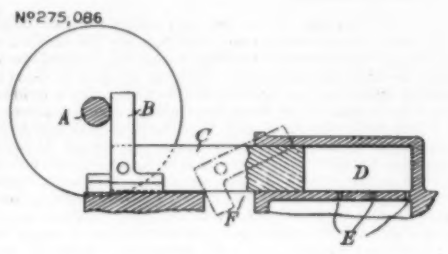
This invention is concerned with the preparation of iron oxide for mixture with powdered aluminium to produce a heating medium for welding and other purposes. The inventor points out that one of the most convenient sources of the oxide is the scale produced in rolling mills; but it suffers from the disadvantage that it contains considerable amounts of impurities. He



consequently crushes the scale between relatively soft rollers A A, which have sufficient tension to pulverise the scale, but are yieldable to harder particles. The material drops from the rolls past an air blast, which blows away any dust. The crushed scale drops through the screen B to be collected, while the harder stuff, which is not crushed, slides away over the top of the screen.—*August 4th*, 1927.

275,086. January 29th, 1927.—MINE TUB CONTROLLERS, B. Norton, Sandford Hall, Claverley, near Wolverhampton.

The characteristic feature of this tub controller is the employment of a cataract cylinder or dashpot so arranged that the tubs are individually checked and then allowed to proceed forward. In the form which we illustrate the tub axle A is caught by the arm B, which is pivoted to the ram C of the dashpot D. The axle pushes the ram forward, the contents of the dashpot



escape by way of the holes E E until the arm arrives at the gap F in the bed-plate. The arm then tilts over, as shown by the dotted lines, and allows the tub to pass on. The ram is then returned to the operative position to catch the next tub.—*August 4th*, 1927.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

THE INSTITUTE OF METALS.—Annual meeting at Derby. For programme see page 148.

THURSDAY TO SATURDAY, SEPTEMBER 8TH TO 24TH.

SHIPPING, ENGINEERING AND MACHINERY EXHIBITION.—Olympia, London, W. 6.

SATURDAY, SEPTEMBER 10TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Town Hall, Lowestoft. Eastern District meeting. 11 a.m.

MONDAY TO THURSDAY, SEPTEMBER 12TH TO 15TH.

INSTITUTION OF PUBLIC LIGHTING ENGINEERS.—Annual meeting and Conference at Brighton.

MONDAY TO SATURDAY, SEPTEMBER 12TH TO 17TH.

INTERNATIONAL CONGRESS FOR TESTING MATERIALS.—At Amsterdam. For programme see page 211.

TUESDAY, SEPTEMBER 13TH.

INSTITUTE OF MARINE ENGINEERS.—85/88, The Minories, Tower Hill, London, E. 1. Presidential address by Engineer-Captain W. Onyon, R.N. (ret.). 6.30 p.m.

TUESDAY, SEPTEMBER 20TH.

INSTITUTE OF MARINE ENGINEERS.—Shipping, Engineering and Machinery Exhibition, Olympia, London, W. 6. Papers: "The Case Against the Airship," by Mr. E. F. Spanner; and "Motor Ships in Relation to World Trade Routes," by Mr. A. C. Hardy. 3 p.m.

TUESDAY TO FRIDAY, SEPTEMBER 20TH TO 23RD.

IRON AND STEEL INSTITUTE.—Autumn meeting in Glasgow. For programme see pages 53 and 263.

FRIDAY, SEPTEMBER 23RD.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—The Building Research Station, Garston, near Watford. South Midland District meeting. 11 a.m.

SATURDAY, SEPTEMBER 24TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—General meeting in the South-Eastern District at Herne Bay. 11 a.m.

CABLE FOR HIGH PRESSURE.—We are informed that on August 9th the new Pirelli 132,000-volt cable, connecting the Hell Gate station of the United Electric Light and Power Company with the Dunwoodie sub-station of the New York Edison Company, was officially put into service. The cable, which is 12 miles in length, is of the single conductor hollow-core oil-filled type. The line comprises three cables, each of which is installed in ducts. This cable is capable of transmitting over 130,000 horse-power and will supply the total electric services of 300,000 people. The line, which will be operated as a part of the New York United Company's system, was installed by the New York Edison and the United Electric Light and Power companies, under the supervision of the engineers of the Pirelli General Cable Works, Ltd., and General Electric Company. A similar Pirelli cable, 6 miles in length, was placed in service in Chicago in June last.

RECONDITIONED BRAZILIAN SCOUT CRUISERS.—In the issue of THE ENGINEER for July 30th, 1926, we described and illustrated the reconditioned Brazilian scout cruiser Bahia, the new machinery for which vessel was designed and built by John I. Thornycroft and Co., Ltd., of Southampton. It will be recalled that the shaft horse-power of the vessel was increased from 18,000 to 20,000, and that a speed on trial of 27 knots was attained, while the radius of action of the ship at 24 knots was increased from 1500 to 2400 knots. We now hear that successful trials have been run with the second reconditioned cruiser Rio Grande do Sul, the machinery for which was also supplied by Messrs. Thornycroft, although the actual installing work was done by the Companhia Nacional de Navigacao Costeria at Rio de Janeiro. Following successful official trials, the Rio Grande do Sul made a lengthy cruise in very heavy weather, in which both the twenty-year old hull and the new turbine machinery proved to be perfectly satisfactory.